FLIGHT
The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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CONTENTS

DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list :—

1925

Mar. 4 .... **Alan Chorlton, Esq. (Managing Director of Messrs. Beardmore, Ltd.): "The All Steel Aircraft," before C.U.Ae.S.**

Mar. 5 .... **Lieut.-Col. C. B. Heald, C.B.E. (Medical Adviser to the Director of Civil Aviation, Air Ministry): "Some Medical Aspects of Air Transport," before R.Ae.S.**

Mar. 6 .... **M. E. Dewoitine: "The Advantages of Metal Construction," before I.Ae.E.**

Mar. 11 .... **G. Bradshaw, Esq.: "The Failure of the Petrol Engine as a Prime Mover."**
Presidential Address. Election of Officers. Before C.U.Ae.S.

Mar. 19 .... **Capt. F. Tymmus: "Practical Navigation of Aircraft," before R.Ae.S.**

Mar. 26 .... **Dr. Eckener (Managing Director, Zeppelin Airship Co.): "Modern Zeppelin Airships," before R.Ae.S. (Society of Arts).**

Apr. 8 .... **Visit (Details announced later).**

Apr. 23 .... **Colonel F. Searle: "The Maintenance of Commercial Aircraft," before R.Ae.S.**

INDEX AND TITLE PAGE FOR VOL. XVI.
The Index and Title Page for Vol. XVI of FLIGHT (January to December, 1924) is now ready, and can be had from the Publishers, 36, Great Queen Street, London, W.C. 2, price 1s. 1d. post free.

EDITORIAL COMMENT.

AN apparent net increase of £652,000 characterises this year's Air Estimates. In view of the various expansions contemplated or in course of development, this may appear little enough, but perhaps a rather more correct picture can be formed as to the importance the air arm is assuming if, to the net total of £15,513,000 shown in the Estimates, are added the amounts provided in the Civil Service and Revenue Department Estimates, and the £1,320,000 which is the Admiralty's contribution in respect of the cost of the Fleet Air Arm. If that is done, the total net expenditure on our air arm and aviation in general reaches the figure of £17,129,762. There can, we think, be little doubt that the Air Estimates will be passed substantially as they stand, as no section of the community wishes to deprive the nation and the Empire of an adequate protection in the air. The only question that can be raised is that of the method of allocating the various sums, and so long as the nation is satisfied that we are getting value for the money spent, there will, we feel sure, be little tendency to grumble, severe as is the taxpayer's burden in other directions.

The Air Estimates

The memorandum by Sir Samuel Hoare, published in full elsewhere in this issue of FLIGHT, explains fairly explicitly the various Votes and the re-arrangements that have been made. In the main, this year's Air Estimates follow previous ones, with the chief exception that this year the Admiralty is, for the first time, to be "allowed" to pay for its own air section. This fact has been regarded in certain quarters as being possibly the "thin end of the wedge," and as marking the beginning of the revival of a separate Naval Air Service. We really do not think this need necessarily be so, as pointed out in an article on the Air Estimates and the other

Services published in another part of this issue. Rather do we regard the change as a very natural one. If the Navy wants aircraft and aviation personnel, let the Navy foot the bill.

As regards the various Votes, space does not permit, nor does it appear necessary, to comment on all 11 Votes. One or two points, however, may be referred to briefly. By far the largest separate Vote is No. 3, Technical and Warlike Stores, the gross expenditure on which is to be £8,581,000, but which is reduced by appropriations in aid, etc., to £5,650,000. Among these appropriations in aid is a contribution by the Admiralty of £1,163,000 in respect of the Fleet Air Arm, and as presumably a considerable portion of this sum (how much exactly is not stated) will be spent under Subhead A (aeroplanes, seaplanes, engines, and spares), the aircraft industry should receive during the coming year fairly substantial orders. Fortunately, the war stocks are by now pretty well depleted, and it may perhaps be hoped that from now onwards the R.A.F., the Navy, and the Army will be equipped with more up-to-date machines than has been the case in the past. Of the three the Navy is the service which has faired best, and there are those who think that the Navy has been over generously treated in the matter of new types, for which at present the Navy has not the accommodation. It is of interest to note that the amounts to be spent on machines, engines, etc., are as follows: Complete machines, £2,908,000; complete engines, £1,537,000; machine spares, parachutes, and miscellaneous, £859,000, and engine spares, £560,000. As these figures are gross, presumably they represent somewhat closely the value of the orders which are to be placed with the aircraft industry. If we assume that out of the £859,000 something like £800,000 is to be spent on aircraft spares, the aircraft manufacturers should receive something like £3,708,000. As there are approximately 20 aircraft firms in existence, this will mean an *average* of £185,400 per firm, which is no more than just sufficient to keep the industry fairly healthy. In view of the relatively smaller number of firms manufacturing aero engines, individual orders to firms would appear to be somewhat larger, but it should be recollected that it is considerably more expensive to produce new types of engines than it is to produce new aircraft.

It is gratifying to find that a saving of £3,000 has been made on the R.A.E. at Farnborough, but the establishment is still costing far too much, and further reductions should be made. On miscellaneous research there is a saving of £11,000, which ought to have been an increase of that amount. This saving is effected under Subhead G of Vote 3, and is on the score of metal construction. How this "cut" is to be justified we fail to see, the actual amount allotted to metal construction this year being £166,000, as compared with £188,000 spent last year. Half a million sterling is provided for the purchase of airships and on airship development. This, of course, is in conformity with the new programme of resumed airship activity.

A net expenditure of £348,000 is contemplated in connection with the new Auxiliary Air Force and Special Reserve, and in view of the importance placed upon these services the amount appears small enough in all conscience. In this connection the memorandum by the Secretary of State for Air makes clear the increase in strength which is contemplated, and although the rate of increase is slower than most could have wished, there is to be a substantial increase, and with that we must, presumably, be satisfied.

£357,000 is to be devoted to Civil Aviation, and compared with the amounts France is devoting to her commercial aviation the amount is indeed a modest one. There is an increase in subsidies of £22,500, which is accounted for by the decision to devote £22,000 to the assistance of light aeroplane clubs. There should thus be good prospects of really getting going with these during the coming summer.

One of the increases which may be begrudged is one of £41,000, in the case of the Air Ministry. To spend rather more than three-quarters of a million sterling on a ministry which deals with a service costing the nation something like 17 millions seems rather disproportionate.

A USEFUL SCHOOL 'BUS: The Gloucestershire Aircraft Co. have produced a new and very interesting type of two-seater dual-control machine, the "Grouse II," Fitted with 180 h.p. Siddeley "Lynx" 7-cylinder radial air-cooled engine, this machine, the "Grouse II" is primarily intended as an intermediate training machine for pilots going over to fast single-seater fighters.

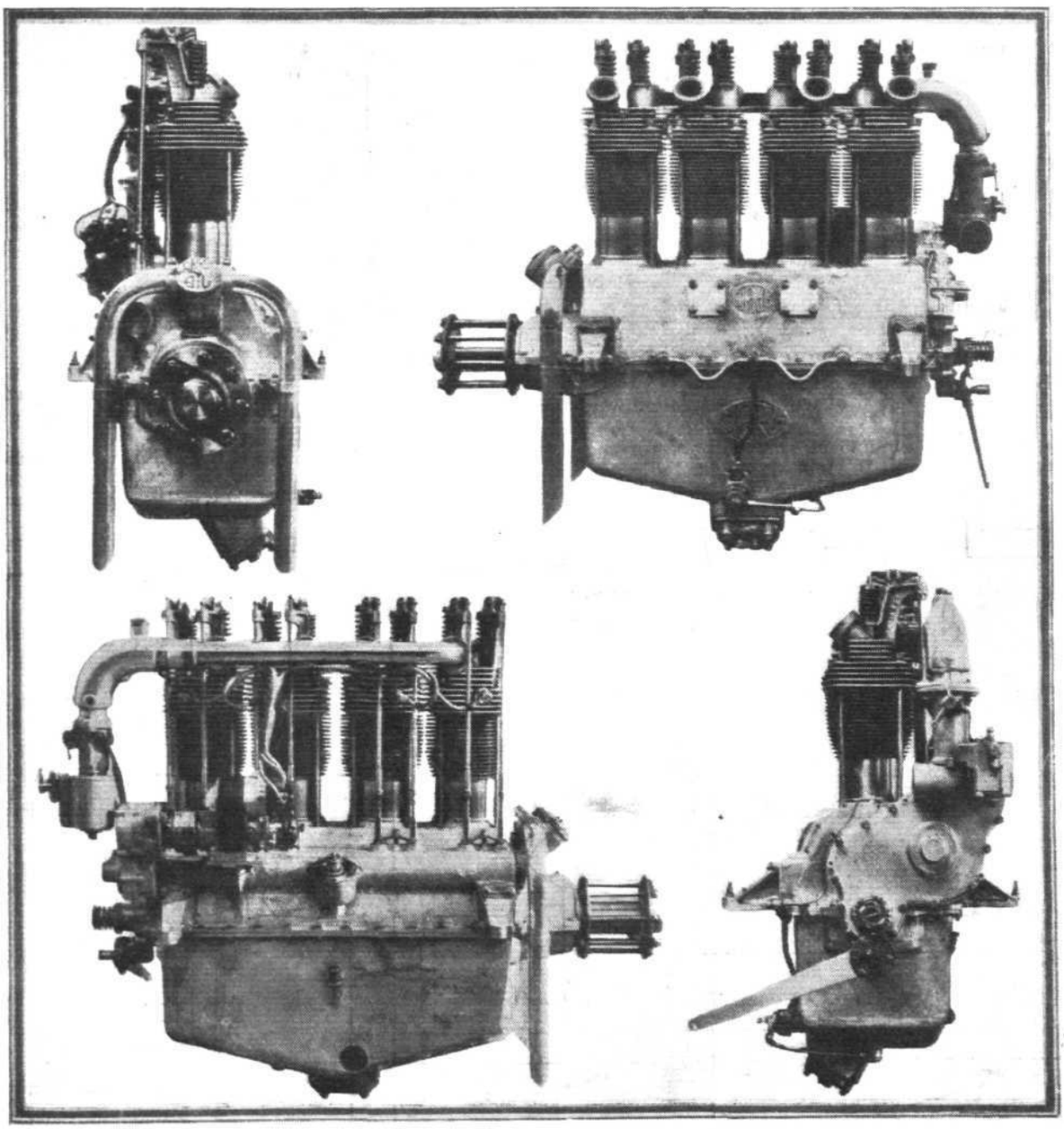
FLIGHT

THE 60 H.P. "CIRRUS" LIGHT 'PLANE ENGINE

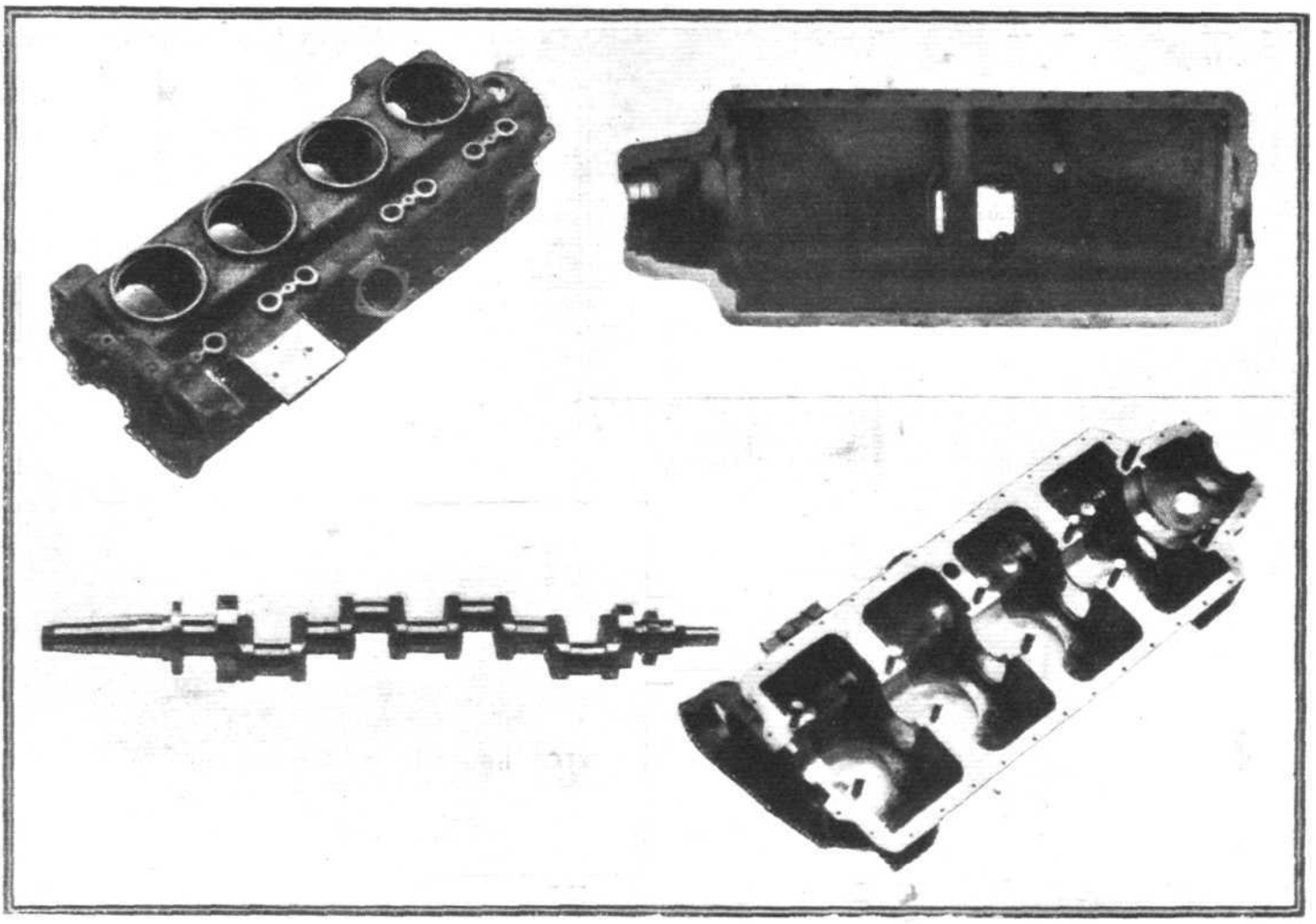
New Aircraft Disposal Co. Production

SIMPLICITY, robustness and ease of maintenance are the features aimed at in the design of the four-cylinder air-cooled engine recently produced by the Aircraft Disposal Co. at their Waddon works. The engine is scarcely a light 'plane engine in the sense to which we have hitherto been accustomed, but there is a large section which maintains that if we are to make any headway at all with popularising flying the very first essential is cheapness, and that cheapness and very light weight are antagonistic terms. Now whatever one's opinions on the subject of what constitutes a light 'plane, it must, we think, be admitted that it is not possible to build a very light machine, nor fly it with a very low-powered engine unless both engine and machine are very lightly built, which is another way of saying very expensively built. If, therefore, it is agreed that cheapness is one of the first considerations (by this we do not, of course, intend to convey the sort of thing described as "cheap and nasty"), it seems almost inevitable that weight must be sacrificed in order to attain low cost. That being so, one may not, perhaps, arrive at a very small machine, nor can one fly it with a particularly small engine, and the logical outcome of this reasoning would seem to be that, whatever form the future light 'plane may take, for the present we must rest content with something a little larger and a little more powerful than we should perhaps have liked if the question of cost did not enter so seriously into the argument.

So far as we have been able to judge the situation, this is the reasoning that has led up, in the first place, to the production of the Airdisco "Cirrus" engine about to be described, and in the second to the designing and building of the D.H. 60 "Moth" low-power two-seater which has just been completed at the Stag Lane works of the de Havilland Aircraft Co. In this connection it should be pointed out that Capt. de Havilland originally conceived the idea of producing the "Cirrus" engine, in so far as he suggested the possibility of taking one-half of the Airdisco 120 h.p. engine and making

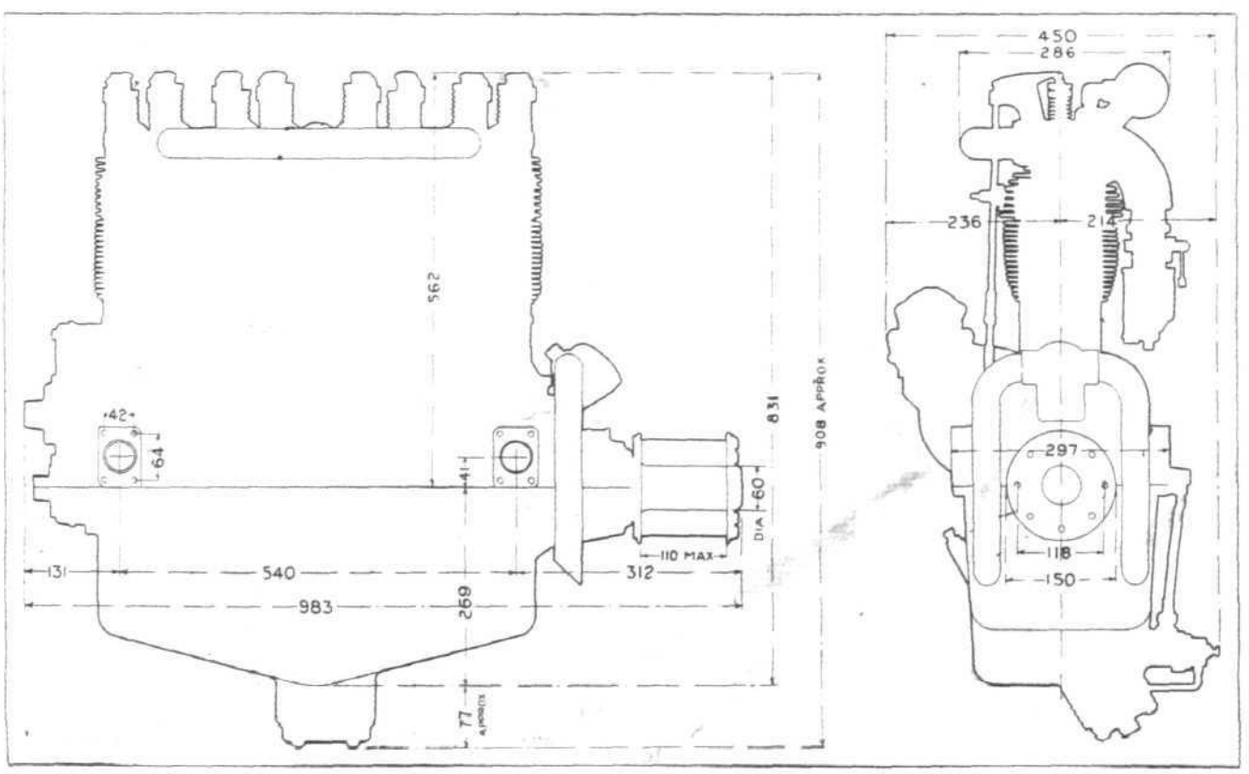


THE AIRDISCO "CIRRUS" ENGINE: Four views of the engine recently produced by the Aircraft Disposal Company for use in low-power aeroplanes. The "Cirrus" has a total cylinder capacity of 4,500 c.c., and develops 60 b.h.p. at 1,800 r.p.m. and 65 h.p. at 2,000 r.p.m. The weight, all-on, is 260 lbs., or 4 lbs./h.p. (on maximum power). The upper left-hand photograph is a front view of the engine, while on the right is the port, or exhaust, side view. The long pipes are crankcase breathers, and are incorporated with the oil-filler cap, which, being outside the cowling, is easily accessible. Below are shown the induction side and, on the right, a rear view. Note the hand-starting gear.

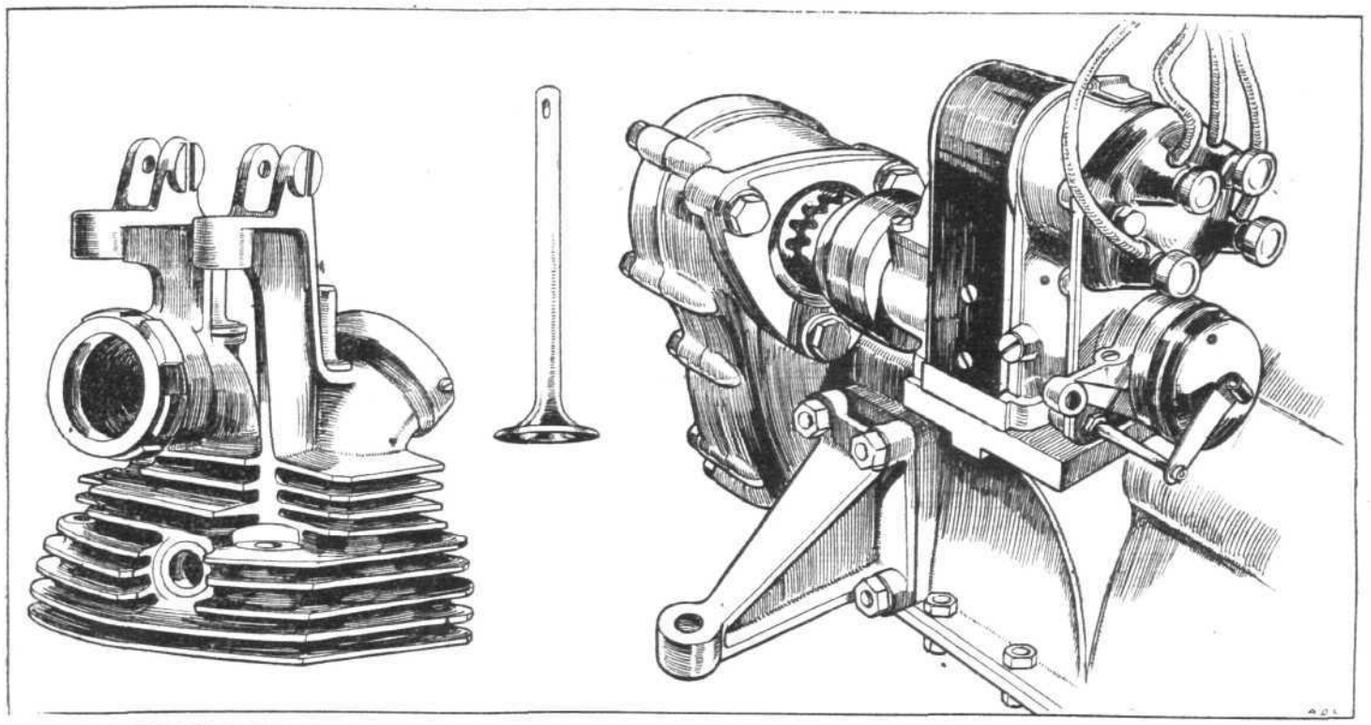


THE AIRDISCO " CIRRUS " ENGINE : Views from above and from below of the top half of the crankcase and internal view of the oil sump, and the four-throw crankshaft. The latter is carried in five bearings, of which the two end ones are ball bearings, the others plain.

thereof a four-cylinder-in-line air-cooled engine of roughly half the power. Major F. B. Halford, who had a large share in the design of the original B.H.P. engine, designed the modifications to the 80 h.p. Renault which resulted in the production of the Airdisco engine of 120 h.p. (in itself a considerable achievement, considering that 50 per cent. more power is



THE AIRDISCO " CIRRUS " ENGINE : This installation diagram shows the main dimensions, etc., so as to enable aircraft designers to see how the engine would fit into any contemplated design. The outline only is shown, but the lugs for the engine " feet " are included so as to give an indication of the spacing.



SOME DETAILS OF THE AIRCRAFT DISPOSAL COMPANY'S "CIRRUS" ENGINE: On the left, a cylinder head minus rockers, etc. In the centre, one of the tulip valves, and, on the right, the magneto, its mounting and drive. An impulse starter is provided so that the engine can be started from the cockpit.

obtained) and on Capt. de Havilland's suggestion he looked into the question of the four-cylinder-in-line air-cooled of about 60 h.p. The result was that Major Halford was able to tell Capt. de Havilland "Can Do" and the "Cirrus" engine was consequently produced. Almost simultaneously the D.H. "Moth" was taken in hand, and probably for the first time in the history of British aviation, engine and machine were completed at approximately the same time. In this connection it is of interest to place on record the fact that the time elapsed from starting to design the "Cirrus" to the first run on the test bench was nine weeks. It is true, of course, that the modifications required were not many, and that practically the only unknown quantity was the new crankcase, but even so we think the Aircraft Disposal Co. may be congratulated.

With these brief explanatory remarks as to why and how the "Cirrus" engine came into being, we may turn our attention to the engine itself. As already stated, the "Cirrus" is a four-cylinder vertical air-cooled engine, and the general lay-out will be seen in the photographs. Practically everything in the engine follows motor car practice, so that the owner-pilot with car experience should have no difficulty in looking after the "Cirrus" in a light 'plane. The four air-cooled cylinders are of cast iron each held down to the crankcase by four long bolts. The cylinder heads are detachable, and are, like those of the Airdisco engine, with which they are interchangeable, of aluminium alloy. It might be mentioned that a great deal of trouble was taken, when designing the new heads for the larger engine, to get them of the correct shape so as to get good cooling, etc., and that naturally the "Cirrus" has benefited to the same extent from this work. There are two valves per cylinder, operated by push-rods and rockers from the camshaft below deck. The external shape of the detachable cylinder heads is shown in a sketch, and it may be mentioned that the combustion chamber is of very smooth and symmetrical shape.

The crankshaft, which is really that of the Airdisco engine, runs in five bearings, of which the front and rear bearings are of the ball type, while the three intermediate bearings are plain. Lest there should be any misgivings on this score, we would point out that exactly the same is the case in the 120 h.p. engine, and that, as crankshaft, pistons, etc., are identical and interchangeable, the loads on the shaft and bearings of the 60 h.p. engine are, of course, very much smaller, and the factors of safety should therefore be more than ample. The connecting rods also are very similar to those of the Airdisco engine, except for such changes as the absence of forking entails.

Practically the only new component in the "Cirrus" is the crank-case, which, it will be seen, is of ample proportions. The top half is heavily webbed for the bearings, while the bottom half forms a very large sump. An oil pump is built into the bottom of the sump and delivers oil to the main bearings under pressure, lubrication being by splash for the rest. In order to prevent an excess of oil from getting up into the pistons and working into the cylinder, baffle plates are placed over the holes in the crank-case, the connecting rods working in slots in these baffle-plates.

All gears are contained in a casing on the rear end of the engine, and from here are driven the camshaft, magneto, oil pump, etc. At present but a single magneto is fitted, firing one plug per cylinder, but, should it be found necessary, provision can easily be made for dual ignition to be incorporated. In fact, we understand that already the next batch of cylinder-heads for the "Cirrus" will have two sparking-plug holes.

In order to facilitate starting, an impulse magneto and hand-starting device is fitted on the rear end of the engine (shown in place on the photographs), so that it is expected that the pilot of the D.H. "Moth" will be able to start his engine without resorting to "prop. swinging."

For mounting in the machine, four brackets are provided on the corners of the engine. Normally no engine "feet" will be provided by the makers of the "Cirrus," as it is thought that aircraft designers may prefer to design their own. Those shown in the photographs are supplied for the D.H. "Moth," but other types can, of course, be employed.

The carburation system has not yet been definitely settled, the arrangement shown in the photographs being suggested by the de Havilland Aircraft Company. The engine which we inspected on the test bench at Waddon had the carburettor placed on the side, and this arrangement is, we understand, preferred by Maj. Halford.

Space does not allow of a more detailed description of the engine at present, but the following brief specification may be of assistance. The "Cirrus" engine weighs 260 lbs., and develops 60 b.h.p. at 1,800 r.p.m. and 65 b.h.p. at 2,000 r.p.m., so that the weight per horse-power on maximum power is 4 lbs. It is expected that the engine will be able to develop the normal 60 h.p. for almost indefinite periods. The bore is 105 mm. and the stroke 130 mm., giving a capacity of 4,500 c.c., which is, of course, considerably in excess of that allowed at Lympne last year. The propeller is direct-driven. The petrol consumption is 0·68 pints/h.p./hour, and the oil consumption 0·033 pints/h.p./hour. The oil sump has a capacity of 12 pints, or sufficient for five hours' flight. The various dimensions are shown on the installation diagram, the overall length being 983 mm. (39·3 ins.), the height 908 mm. (36·3 ins.), and the width 450 mm. (18 ins.). Further particulars and demonstrations on application to the Aircraft Disposal Company, Ltd., Regent House, 89, Kingsway, London, W.C. 2.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

COMMITTEE MEETING

A MEETING of the Committee was held on February 18, 1925, when there were present :—Lieut.-Col. F. K. McClean, A.F.C., Mr. E. C. Bucknall, Lieut.-Col. M. O. Darby, Group-Capt. C. F. Kilner, D.S.O., Mr. T. O. M. Sopwith, Capt. C. B. Wilson, and the Secretary.

Committee Elections.—Group-Capt. C. F. Kilner, D.S.O., and Capt. C. B. Wilson, were co-opted to the Committee.

Election of Members.—The following new Members were elected :—

Flying Officer Edward H. M. David.
Flight-Lieut. James Prendergast.
Squad.-Leader Reginald Stuart Maxwell.
Group-Capt. Cecil Francis Kilner.
Herbert Harry Morris.
Reginald John Parrott.
Ernest Gilbert Richardson.
George Sydney Coggan.
Flying Officer John Gosset Hawtrey.
Flying Officer Edwin Frank Mattock.
Flying Officer John Vaughan Roberts.
Thomas Herbert Ottewill Richardson.
Flying Officer Oswald Denzil Freeman.
The Rt. Hon. The Earl of Kinnoull.
Flying Officer William Shepherd Allen.
Flight-Lieut. David Vaughan Carnegie.
Allen Julyeen Donkin.
Flying Officer John Harvey Hutchinson.
Flying Officer Maurice Vavasour Ward.
Flying Officer William Frost Davenport.
Ronald David de Pass.

Committee Reports.—Reports from the following Committees were received and adopted :—House Committee, Racing Committee, Joint Standing Committee, R.Ae.C. and S.B.A.C.

Light Aeroplane Clubs.—Col. M. O. Darby reported on the Conference of Light Aeroplane Clubs, held at Leeds, on February 7, at which he and the Secretary represented the Light Aeroplane Section of the Royal Aero Club.

The Royal Aero Club had represented to the Air Ministry that the proposed financial assistance to Clubs was inadequate, and the Air Council were now considering an amended scheme. It was hoped the decision on this matter would be received in a few days.

High Speed Course and Automatic Timing Apparatus.—The Secretary reported on the Conference at the Air Ministry on February 10, presided over by Lieut.-Col. J. A. E. Edwards, C.M.G., at which the Club had been represented by Lieut.-Col. M. O'Gorman, Major R. H. Mayo and himself. The Air Ministry had promised to obtain reports on certain sites likely to be suitable for a High Speed Course of 3 kilometres.

Experiments were now being made with an automatic timing apparatus, and it was decided to wait for reports on the trials. The distinctive characters of recording instruments required for record purposes were also discussed, and the Air Ministry had promised to report to the Club the results of various experiments which were now in progress.

RACING COMMITTEE

A MEETING of the Racing Committee was held on Wednesday, February 11, 1925, when there were present :—Lieut.-Col. M. O. Darby, in the Chair, Lieut.-Col. W. A. Bristow, Capt. R. J. Goodman Crouch, Lord Edward A. Grosvenor, Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S., Lieut.-Col. F. K. McClean, A.F.C., Sir Guy Standing, K.B.E., Capt. C. B. Wilson, Mr. Howard T. Wright, and the Secretary.

The following attended at the invitation of the Club :—Air Vice-Marshal Sir Geoffrey Salmond, K.C.M.G., C.B., D.S.O., Air Commodore F. C. Halahan, C.M.G., C.B.E., D.S.O., Lieut.-Col. L. F. R. Fell, D.S.O., O.B.E., Major J. C. Buchanan, O.B.E.

A general discussion took place as to the possibility of organising a competition for light aeroplanes this year.

The following committee was appointed to further consider the matter and report :—Air Commodore F. C. Halahan, Lieut.-Col. L. F. R. Fell, Major J. C. Buchanan, Lieut.-Col. M. O. Darby, Lieut.-Col. W. A. Bristow and Capt. R. J. Goodman Crouch.

JOINT STANDING COMMITTEE, R.AE.C. AND S.B.A.C.

A MEETING of the Joint Standing Committee of the R.Ae.C. and S.B.A.C. was held on Wednesday, February 11, 1925, when there were present :—

Royal Aero Club.—Lieut.-Col. F. K. McClean, A.F.C., in the Chair, Lieut.-Col. W. A. Bristow, Lieut.-Col. M. O. Darby, Lord Edward Grosvenor.

Society of British Aircraft Constructors.—Capt. H. E. P. D. Acland, Commander James Bird, Mr. H. T. Vane.

In attendance :—C. V. Allen, Secretary, S.B.A.C.; H. E. Perrin, Secretary, R.Ae.C.

The King's Cup Race.—The regulations drawn up by the Racing Committee were considered and approved subject to a further discussion of one or two points. The race will be held on Friday and Saturday, July 3 and 4, 1925.

The course will be London to Glasgow and back each day. Controls will probably be at Bristol, Harrogate, Manchester and Newcastle. Competitors will stop half-an-hour at each control, and one hour at Glasgow (Renfrew aerodrome).

The start and finish each day will be at the London aerodrome, Hendon. The first circuit must be completed by 10 p.m. on the first day. Aircraft will be started each day on handicap times.

Easter Meeting.—Owing to the difficulties of obtaining a sufficient entry and also to the fact that the London aerodrome, Hendon, would not be available, it was decided to abandon the proposed Easter race meeting.

Aerial Derby.—The question of the course for the Aerial Derby (International Speed Contest) was considered and deferred.

Schneider Cup.—It was reported that the race would be held at Baltimore between October 24 and 29, 1925. The result of the Club's interview with the Under Secretary of State for Air was reported.

HOUSE COMMITTEE

A MEETING of the House Committee was held on Monday, February 16, 1925, when there were present :—Mr. Ernest C. Bucknall, in the Chair, Major Graeme Anderson, Major Herbert J. Corin, Mr. J. S. Mallam, Mr. D. C. MacLachlan, Capt. L. V. Pearkes, Major S. V. Sippe, and the Secretary.

Election of Members.—The list of new Members proposed for the Club was considered.

Alterations to Club Premises.—The committee inspected the various alterations being made at the Club.

CLUB PREMISES

THE structural alterations to the Club premises are being proceeded with as rapidly as possible so as to cause little or no inconvenience to Members. The entrance to the Club in Clifford Street is closed, and the new entrance is in Old Burlington Street. There is no change in the postal address.

Offices : THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W.1.
H. E. PERRIN, Secretary

AIR SERVICE RE-UNIONS AND FUNCTIONS

Second Annual (R.A.F.) India) Re-union Dinner

THE annual R.A.F. (India) Re-union Dinner for officers who have served with the R.A.F. in India will be held this year at the Savoy Hotel at 7.30 p.m. (for 8 p.m.) on Saturday, March 14, 1925 (the day of the R.A.F. *v.* Army Rugby football match at Wembley). Tickets, 15*s.* 6*d.*, exclusive of wines. Evening dress and miniatures to be worn. It is requested that applications for tickets be made as early as possible, accompanied by remittances, to Flight-Lieut. F. L. B. Hebbert, Air Ministry, Kingsway, W.C. 2, from whom full details can be obtained.

FLIGHT
AIRCRAFT ENGINEER AIRSHIPS

LIGHT 'PLANE AND GLIDER NOTES

THE new de Havilland "Moth" made its first flight last Sunday afternoon, and, although the flight was only a comparatively short one, the machine was found to be in perfect trim, handle easily and smoothly, and, last but not least, appeared to exceed the estimated performance at both ends of the scale. The top speed was above 90 m.p.h., and the landing speed about 37 m.p.h. The "Cirrus" engine ran perfectly, and altogether the first flight gave great promise. It is of interest to mention that Capt. de Havilland himself tested the machine—a fact which should certainly help to inspire confidence. Next week we hope to have something more to say about the D.H.60 "Moth." In the meantime, an illustrated description of the "Cirrus" engine will be found in this issue of FLIGHT.

* * *

WITH the advent of the "Cirrus" engine, and the present tendency to regard some 60 h.p. or so as permissible for a light 'plane, there seems to be an excellent opportunity for reviving the famous Avro "Baby." In the single-seater form this machine flew, it will be remembered, from London to Turin without landing, piloted by Bert Hinkler. In Australia Hinkler also made long flights, so that the reliability of the Green engine seems to have been established. That the engine is perfect will hardly be claimed for a design some 13 or 14 years old, but it would appear that such changes as seem to be required are not very extensive, and certainly not radical, so that perhaps we may also see the "Evergreen" getting a new lease of life. The question of water-cooling or air-cooling for light 'plane engines does not yet appear to have been settled, so that there is still an opportunity for the former.

* * *

WE are living at a critical time, so far as light 'planes are concerned, at any rate. The fate of the light 'plane is very much in the balance at the present moment, and a great deal may, and probably will, depend upon the decisions made during the next few weeks. From the somewhat optimistic times of 1923, when there was a widespread idea that the era of the "flying motor-cycle" had arrived, we have passed through the stage of two-seaters with relatively smaller power, and it would appear that informed opinion is now rather abandoning the idea of the ultra low-power machine and turning to something round about 60 h.p. for two-seaters.

* * *

THE fact (if it be a fact) is to be regretted in many ways, and we personally are not yet convinced that the jump from 1,100 c.c. to 4,500 c.c. is really required. On the other hand, the Lympne engines of last year were giving, on an average, something like 34 h.p. for 1,100 c.c. capacity, and so the increase in actual power is not so great as the sudden jump in cubic capacity would indicate. We do think that an increase in power was required, and as the plans for this year are to abandon capacity restrictions altogether, the jump from 34 to 65 h.p. may be justified. In the case of the "Cirrus" engine there was already a larger type in existence, whose cylinders, pistons and crankshaft could be utilised, and doubtless this is one of the reasons for the somewhat large capacity of 4½ litres. And it should be remembered that at the moment the demand for light 'plane engines cannot be expected to be a large one, and that therefore the production of a low-price engine, even if somewhat on the large side, may be expected to balance the slight disadvantage of an engine somewhat large for the job.

* * *

THERE is another point which is, perhaps, apt to be lost sight of, and that is that we have hitherto been in the habit of thinking of the light 'plane as one single type. Now there is really no reason why that should be so. On the contrary, even in the light 'plane class it seems reasonable to suppose there will be a number of types, such as the school machine, the touring machine for the private owner, the sporting machine with, possibly, light construction and a high-efficiency engine, and the racing type. There should, among all those types, be plenty of room for the low-price, somewhat large, but very robust machine and engine, just as there will be room for the more refined racing type. After all, to take an instance from the automobile world, light cars are of many types and of many qualities and prices without ceasing to be light cars. Why should not the same apply to light aeroplanes? From this point of view, therefore, we welcome the production of the "Cirrus" engine and the De Havilland "Moth," both of which should fill a very useful gap and should do much to get sporting flying re-established on a sound basis.

* * *

IN fact, we may look forward to the day when there are low-power aeroplanes, light 'planes, lighter 'planes, and slightly slighter 'planes! The one great thing achieved at the moment is that we have got away from the capacity rating, and that some other figure, probably the total weight, will form the basis of the future light aeroplane as a class.

* * *

THE paper by Col. Fell on light 'plane engines, reported elsewhere in this issue, came at a very opportune moment, and the discussion which followed it showed the trend of modern opinion. Most of the various points raised by Col. Fell were dealt with during the discussion, but there are one or two to which we should also like to draw attention here.

* * *

ONE sentence in Col. Fell's paper seems open to challenge. He said (after having stated that "the public and even aircraft designers have been misled as to the type of engine that is required by statements made in the non-technical and semi-technical press, to the effect that it is possible to fly an aeroplane satisfactorily with a motor-cycle engine"): "At this stage it is desired to state quite definitely that this is impossible." Col. Fell promised figures to back up his statement, but failed to give them. Now this statement should not be allowed to pass unchallenged. To begin with, on whose authority is it desired "to state definitely that this is impossible"? And in what sense is it impossible? We do not think Col. Fell can have seen Longton flying the English Electric Co.'s "Wren" with 400 c.c. A.B.C. motor-cycle engine at Lympne in 1923, otherwise he would not have made such a sweeping statement. In point of fact, the "Wren" had approximately the same performance as a Maurice Farman "Shorthorn"; she was remarkably stable and, in spite of her very light wing loading, was but little affected by gusts. Longton's "crazy flying" on her was a wonder to behold, and certainly the machine was not underpowered.

* * *

IF Col. Fell refers to two-seaters, we would call his attention to the performance curves of the Beardmore "Wee Bee" of last year (published in FLIGHT of September 25, 1924). These curves (which have, incidentally, been substantiated by the machine's actual performances) indicate that the power reserve is a considerably greater percentage than that of the majority of commercial aeroplanes. Apart from the fact that the "Cherub" is not a motor-cycle engine, although it is, presumably, among those which Col. Fell considers as such, there is thus no difficulty in disproving what can only be described as a far too sweeping statement. If Col. Fell had qualified his statement by saying that it was impossible to fly with such engines in machines that could be commercially produced, few would probably have disagreed, but technically there is nothing at all impossible in flying with a motor-cycle engine (or was not until the Technical Department started to insist on changes and additions in certain machines, which resulted in the engines having to be "faked" also). And, on the whole, the motor-cycle engines behaved remarkably well, and many machines put up very creditable performances, such as Hinkler's 1,000 miles without a forced landing.

* * *

FOR the first time in history the Air Estimates, recently issued, contain an item referring to light 'planes. This is subhead F.2 under Vote 8 (Civil Aviation), and laconically reads: "Assistance to Light Aeroplane Clubs, £22,000." In his memorandum on the Air Estimates, Sir Samuel Hoare merely states: "A sum is also included for the first time this year to assist in the establishment and maintenance of a limited number of light aeroplane clubs. The details of the scheme are still under discussion."

* * *

IT may be recollected that the original scheme included the grant to each of ten clubs of an annual subsidy of £2,000, but that number of clubs has been reduced to six for the present In view of the fact that the offer of £2,000 was, on closer examination, found to be inadequate, the total to be voted does not appear any too large, but if the number is, for the present, to be restricted to six (not that we necessarily agree that this number is sufficient), there should be a possibility of getting started in real earnest, with a reasonable amount of financial assistance for each of the six.

LIGHT 'PLANE CLUB DOINGS

WE shall be pleased to have reports regularly from Club Secretaries, or those directly connected with new Light 'Plane Clubs, so that by keeping our readers informed on this matter the whole movement may be helped forward to the benefit of the clubs and the popularising of "that Air feeling."

Light 'Plane Clubs are being, or have been, formed at :—

London.—Lieut.-Com. H. E. Perrin, Secretary, Royal Aero Club, 3, Clifford Street, W.1.

Birmingham.—Major Gilbert Dennison, Hon. Secretary, Midland Aero Club, Handsworth, Birmingham.

Glasgow.—J. Allison, Esq., Jnr., 219, St. Vincent Street.

Lancashire.—C. J. Wood, Esq., Secretary, Lancashire Aero Club, c/o A. V. Roe and Co., Newton Heath, Manchester.

Newcastle-on-Tyne.—Alex. H. Bell, Esq., Hon. Sec., Newcastle-on-Tyne Light 'Plane Club, County Hotel.

Yorkshire.—Prof. G. Brodetsky, Yorkshire Aeroplane Club, Leeds University.

We have received the following reports on the progress being made :—

Lancashire Aero Club.—The second annual meeting of the Lancashire Aero Club was held at the Milton Hall, Deansgate, Manchester, on February 19. The Secretary, Mr. C. J. Wood, gave a report on the past year's work, and Mr. M. Lacayo, Chairman of the Financial Committee, read a statement and explained that the balance sheet would be placed on the club notice board in the new club room. The following Vice-Presidents were re-elected : John Lord, Esq., C.B.E., Sir William Veno, Colonel Groves, T.D., Sir William Kay, the Lord Mayor of Manchester, and the Mayor of Salford.

The committee was enlarged from seven members to eleven, the following members being elected by ballot to the committee : Messrs. A. Ainsworth, H. Bayliss, D. F. Dyson, A. Goodfellow, O. Groves, F. J. Leeming, J. H. Miede, and T. Prince.

Messrs. Lacayo, Salthouse and Williams did not retire this year and remain on the committee.

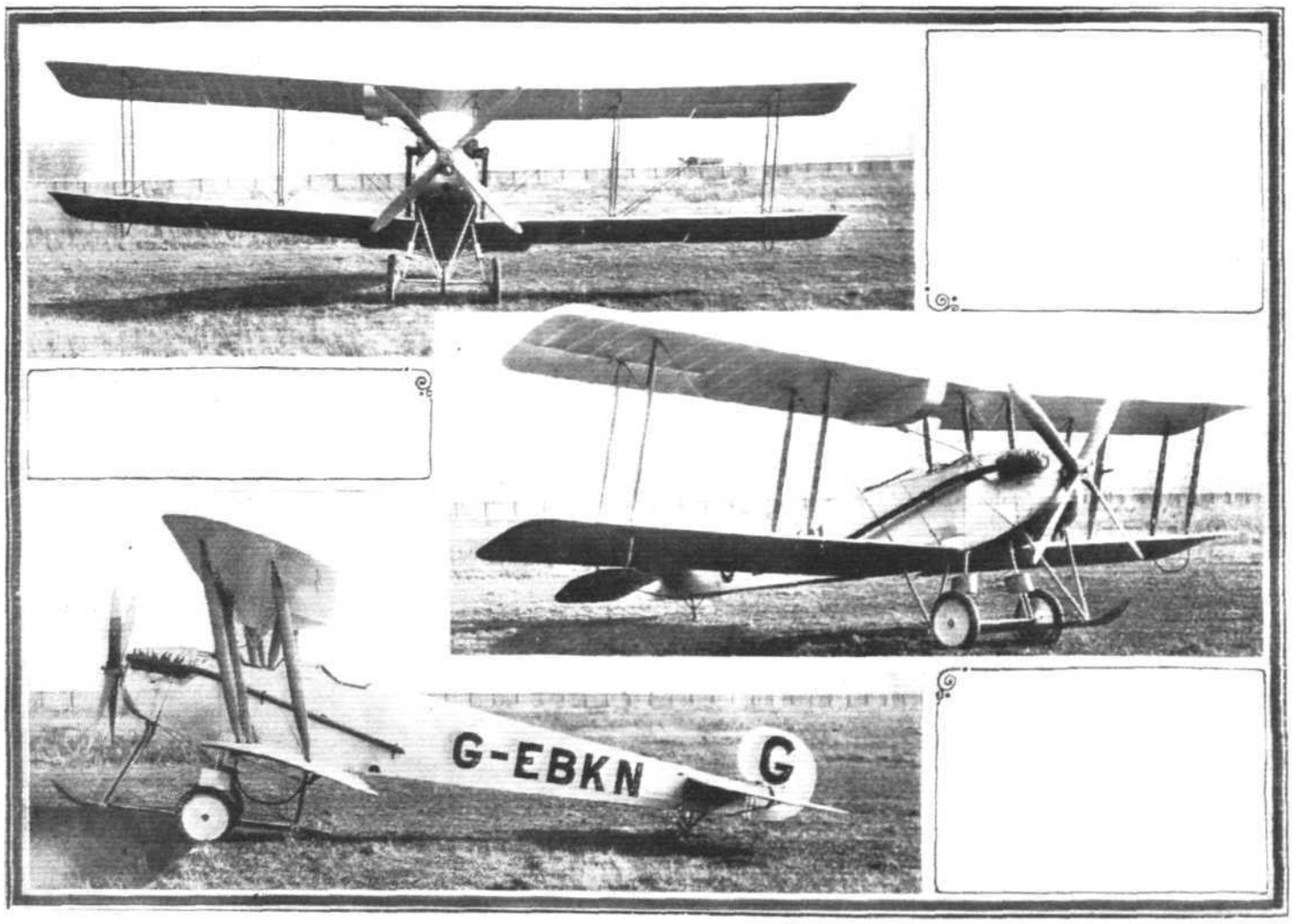
Mr. John F. Leeming was re-elected Chairman and Mr. Rex Williams Deputy Chairman.

The Secretary read the rules, which were passed unaltered ; and Mr. Williams explained that a club room had been obtained at the Nag's Head Hotel, Lloyd Street, Deansgate, Manchester, where members could obtain lunch and refreshments. The room is to be refurnished and redecorated, and will be at the disposal of members every day and evening except Wednesday, when it will be required for committee meetings. Mr. C. J. Wood described how a large garage had been rented in Manchester, and that the Club's Avro 504K would be brought there in the course of a week or so, when members will be busy re-conditioning this machine so that it may be ready to fly when the new aerodrome at Woodford is completed.

Newcastle-upon-Tyne Light Aeroplane Club.—There is little to report from this club, but we illustrate herewith a sketch of the club badge, which has been designed by Miss Mary Bell, who is well known in the art world in this town.

Another Light 'Plane Club Badge : Sketch of the badge adopted by the Newcastle-upon-Tyne Light Aeroplane Club, designed by Miss Mary Bell.

Mr. Alex. Peacock has arranged to carry on a class for student members and any others interested in model aeroplane design and construction. This should see the club through the period of inactivity till the light aeroplanes arrive.



AN AIRDISCO "AVRO" : This machine, an Avro 504, is fitted with the new Airdisco engine of 120 h.p. The "Cirrus" engine is developed from this engine, being in effect one-half of it, cylinders and pistons being interchangeable. The Avro-Airdisco should be a very useful training machine of the medium-power type.

FLIGHT
AIRCRAFT ENGINEER AIRSHIPS

THE AIR ESTIMATES

A Net Increase of £652,000

THE Air Estimates for the financial year 1925-26 were issued on February 19, and show a net increase over last year's estimates of £652,000. The gross estimate is £21,319,300, but appropriations-in-aid are expected to reach the value of £5,806,300, thus reducing the total to £15,513,000, as compared with a net estimate of £14,511,000 for the year 1924-25. Owing to supplementary estimates the figure of actual expenditure (which is the one given in this year's paper) during last year was slightly greater, *i.e.*, £14,861,000. Out of the net total just given, non-effective services account for a net estimate of £143,000, representing an increase, under this head, of £10,000. There is also an increase of 1,000 in personnel, *i.e.*, from 35,000 to 36,000.

Effective services are estimated to require the following amounts :—

Votes.	Net Estimates. £1925-26.	£1924-25.
1. Pay, etc., of the R.A.F. ..	3,412,000	2,941,000
2. Quartering, stores (except technical) Supplies and Transport	1,459,000	1,452,000
3. Technical and warlike stores (including experimental and research services)	5,650,000	6,050,000
4. Works, buildings and land ..	2,572,000	2,127,000
5. Medical services	204,000	195,000
6. Educational services	486,000	480,000
7. Auxiliary and reserve forces ..	348,000	284,000
8. Civil aviation	357,000	355,000
9. Meteorological and miscellaneous effective services ..	131,000	134,000
10. Air Ministry	751,000	710,000
Total effective services ..	£15,370,000	£14,728,000
11. Non-effective services (half-pay, pensions, etc.) ..	143,000	133,000
Total effective and non-effective services	£15,513,000	£14,861,000
Total net increase	£652,000	

Personnel

The grouping and numbers of persons this year are as follows :—Under Vote 1 : Air officers, 21 ; Commissioned Officers, 3,033 ; Warrant Officers, 271 ; Non-Commissioned Officers, 4,205 ; Airmen, 21,147 ; Boys, 403. Total Vote 1, 29,080. Under Vote 3 : Commissioned Officers, 33 ; Warrant Officers, 2 ; Non-Commissioned Officers, 8 ; Airmen, 9. Total Vote 3 : 52. Under Vote 5 : Commissioned Officers, 218 ; Warrant Officers, 12 ; Non-Commissioned Officers, 190 ; Airmen, 1,213. Total Vote 5, 1,633. Under Vote 6 : Air Officers, 3 ; Commissioned Officers, 150 ; Cadets, 130 ; Warrant Officers, 45 ; Non-Commissioned Officers, 400 ; Airmen, 2,003 ; Boys, 2,149. Total Vote 6, 4,880. Under Vote 7 : Commissioned Officers, 25 ; Warrant Officers, 7 ; Non-Commissioned Officers, 47 ; Airmen, 128. Total Vote 7, 207. Under Vote 10 : Air Officers, 11 ; Commissioned Officers, 133 ; Warrant Officers, 1 ; Non-Commissioned Officers, 3. Total Vote 10, 148. It is pointed out that the numbers provided for under Votes 1 and 5 include Army personnel attached to the Royal Air Force.

Financial Expenditure

Under Vote 1 the summarised figures are as follows : Pay and personal allowances of officers, £1,394,700 ; pay and personal allowances of men, £2,351,400 ; marriage allowance, £122,000 ; miscellaneous allowances, £15,900 ; civilians £731,300 ; service gratuities to officers and men on discharge, £8,000 ; recruiting staff and expenses, £18,200. Gross total, £4,641,500. Appropriations-in-aid reduce this to the net figure of £3,412,000. The net increase under this Vote is £471,000.

Under Vote 2 the summarized figures are : Lodging allowances and billeting, £112,000 ; barrack services, £57,000 ; fuel and light, £222,000 ; general stores, £209,000 ; clothing £313,000 ; provisions and horses, £926,000 ; transport, £520,000. Gross total £2,359,000. Appropriations-in-aid, £900,000. Net total, £1,459,000. Net increase, £7,000.

As in previous years the most interesting of all is Vote 3, Technical and Warlike Stores, which provides for the following amounts : Aeroplanes, seaplanes, engines and spares, £5,864,000 ; Royal Aircraft Establishment, Farnborough, £37,000 ; Aeronautical Inspection Department, £151,000 ; aircraft, technical and warlike stores, £198,000 ; armament and ammunition, £415,000 ; electrical stores, £296,000 ; miscellaneous research, £253,500 ; miscellaneous materials, £300,000 ; balloons and hangars, £42,000 ; mechanical and other transport, £309,000 ; petrol and oil, £458,000 ; war liabilities (rewards to inventors and miscellaneous claims), £57,500 ; airships, purchase of, £60,000 ; airship development, £440,000. Gross total, £8,881,000. Appropriations-in-aid, £2,931,000. Deduct for probable underspending on the Vote as a whole £300,000. Net total, £5,650,000, representing a net increase of £400,000.

It is of interest to note that under sub-head A (aeroplanes, seaplanes, engines and spares) the following amounts are contemplated : Complete machines, £2,908,000 (£2,789,700 in 1924-25). Complete engines, £1,537,000 (£1,450,700 in 1924-25). Machine spares, parachutes and miscellaneous, £859,000. Engine spares, £560,000. The increase under this subhead is £719,500.

The summarised statement under Vote 4 is as follows : Staff for works services, £257,000 ; new works, additions and alterations amounting to £2,000 each and upwards, £1,806,000 ; ditto under £2,000, £93,500 ; ordinary repairs, renewals and maintenance, £624,000 ; grants in aid of works, £9,000 ; purchase of lands and buildings, £400,000 ; rents, compensations and reinstatements, £88,000 ; incidental expenses of Air Ministry estates, £10,000 ; provision of telephone and telegraph service, £1,000 ; miscellaneous works services, £12,000 ; stores and plant for works (net), £38,000 ; machine tools, £19,800. Gross total, £3,282,300. Deduct for probable underspending £200,000, and for appropriations in aid £510,300. Net total, £2,572,000, representing a net increase of £445,000.

The Medical Services (Vote 5) are estimated to require £204,000, as follows :—Pay and personal allowances of officers, £133,000 ; pay and personal allowances of airmen, £116,600 ; nursing service, £32,600 ; fees, etc., to civil medical practitioners, £4,500 ; civilians employed in hospitals and sick quarters, £8,500 ; medical stores and supplies, £16,500 ; payments to hospitals, £36,500 ; miscellaneous charges, £7,300. Gross total £355,500. Deduct appropriations in aid, £151,500. Net total, £204,000, or a net increase of £9,000.

Educational Services (Vote 6) are estimated to require the following amounts : R.A.F. Staff College, Andover, £13,000 ; R.A.F. Cadet College, Boys' Wing, Cranwell, £185,500 ; School of technical Training (Boys), Halton, £256,500 ; general and vocational training of airmen, £44,100 ; miscellaneous educational services, £3,900 ; gross total, £503,000. Deduct appropriations in aid, £17,000 ; net total, £486,000, a net increase of £6,000.

Vote 7, Auxiliary and Reserve Forces, is divided this year into three sections, owing to the initial formation of Special Reserve and Auxiliary Air Force Units. The figures under the various subheads are as follows :—*R.A.F. Reserve* : Pay and personal allowances of permanent staff, £4,900 ; pay and personal allowances during training, £17,500 ; reserve pay, £147,000 ; capitation payments to civil companies for training, etc., courses, £130,000 ; miscellaneous expenses, £2,600. *Special Reserve* : Pay and personal allowances of regular staff, £13,000 ; training, etc., £1,600 ; miscellaneous expenses, £500. *Auxiliary Air Force* : Pay and personal allowances of regular staff, £14,700 ; grants to county associations, £7,400 ; training, etc., £4,500 ; miscellaneous expenses, £5,300. Gross total, £349,000 ; deduct appropriations in aid, £1,000 ; net total, £348,000, an increase of £64,000.

Civil aviation calls for an expenditure of £357,000 as follows : Civil aviation aerodromes, £35,000 ; aerial routes, surveys, etc., £37,000 ; technical equipment, £12,000 ; works, buildings and lands, £123,000 ; miscellaneous, £3,000 ; civil aviation subsidies, £159,500. Gross total, £369,500. Deduct appropriations in aid, £12,500. Net total, £357,000, a net increase of £2,000.

Meteorological and miscellaneous effective services demand £131,000 under the following subheads : Compensation for losses, £24,000 ; losses by exchange, etc., £1,000 ; medals, £100 ; telegraphic and telephonic charges, £57,400 ; meteorological services, £77,000 ; miscellaneous, £17,000 ; allowances to ministers of religion, £5,500. Gross total, £182,000. Deduct appropriations in aid, £51,000. Net total, £131,000.

No less a sum than £751,000 is required for the Air Ministry, the items under the various subheads being : Salaries and allowances of the Air Council, and Department of the

Secretary, £303,332; salaries and allowances of the department of the chief of the air staff, £175,682; salaries and allowances of the department of the air member for personnel, £51,982; salaries and allowances of the department of the air member for supply and research, £131,473; salaries and allowances of the directorate of civil aviation, £15,562; salaries and allowances of the meteorological office, £48,123; pay of messengers, porters, etc., £24,246; contingent expenses, £1,600. Gross total, £752,000. Deduct appropriations in aid, £1,000. Net total, £751,000, a net increase of £41,000.

The last Vote No. 11 is for non-effective services (half-pay, pensions, and other non-effective services), and is estimated to require £143,000 net, as follows: Rewards to Officers, Warrant Officers, Non-Com. Officers and Airmen, £350; half-pay of officers, £3,700; service and disability retired pay and gratuities of Officers, £73,600; pensions and gratuities to wounded Officers, £800; Service and disability pensions and gratuities—Warrant-Officers, Non-Com. Officers and Airmen—£30,100; pensions, gratuities and allowances to widows, children, etc., £11,600; civil non-effective payments; recurrent charges, £4,900; civil non-effective payments, gratuities and other non-recurrent charges, £5,250; injury grants, £8,300; commutation of retired pay, wounds, pensions, etc., £5,400; relief fund, £500. Gross total, £144,500. Deduct appropriations in aid, £1,500. Net total, £143,000, an increase of £10,000.

As usual, a statement by the Secretary of State for Air accompanies the Air Estimates, in which Sir Samuel Hoare elucidates certain points. This memorandum is published in full below.

MEMORANDUM BY SECRETARY OF STATE FOR AIR

THE arrangement of Air Votes for the coming year is unchanged, but there are two new features as compared with last year's Estimates. Provision is now made under Vote 3 for Airships, the initial provision for this service in the current year having been made by a special Supplementary Vote; and a grant from Navy Votes in respect of the cost of the Fleet Air Arm is credited to Air Votes, being shown under Appropriations-in-Aid in Air Votes 1 (Personnel), 2 (Quartering, etc.) and 3 (Technical Equipment). This latter change is in accordance with a ruling of the Treasury arising out of the fourth recommendation of the Sub-Committee of the Committee of Imperial Defence which reported in 1923 on the relations of the Navy and the Air Force. (Cmd. 1938.)

The net amount of expenditure under Air Votes which Parliament is asked to authorise in 1925-26 is £15,513,000. Account has also to be taken of expenditure by the Colonial Office under the Middle East Vote (Defence sub-head) amounting to £3,116,700 (Iraq £2,744,100, Palestine and Transjordan, £372,600) and by the Admiralty under a Vote for the Fleet Air Arm amounting to £1,320,000. These two sums are shown as contributions towards the gross Air Votes, and, when added to other repayments and ordinary appropriations-in-aid, explain the large difference between the net figure already mentioned and the gross figure of £21,319,300.

The apparent net increase as shown on the face of the Estimates is £652,000, but when account is taken of the provision made in the net Estimates of 1924-25 for the Fleet Air Arm, the effective net increase is £1,972,000. There is a decrease of £592,000 in the expenditure on air and ancillary services in the Middle East, which affects the gross and not the net total.

For some years past Air Estimates as voted have exceeded actual expenditure by a considerable (though decreasing) amount. Having regard to this tendency (for which some justification may be found in the circumstances of a new and expanding Force) it has been thought judicious to make special overhead deductions from the amount of the provision under Votes 3 (Technical Equipment) and 4 (Works) which cover the main items of contract expenditure and are thus most liable to unexpected delays, with consequent failure to spend. These deductions, amounting together to £500,000, have been superimposed on a normal allowance for the difficulties of one kind and another which are found to impede progress on approved services, and they have therefore been applied to the gross total of each Vote, and not to the individual sub-heads. This reduction of the money provision is not intended to affect the normal progress of expansion for Home Defence and of other approved services, and, should the calculation hereafter prove to have been mistaken, Parliament would in due course be invited to make good the deficiency to such extent as might be required.

My predecessor in his memorandum accompanying the Estimates for 1924-25 pointed out that the total of Air Estimates must be expected to rise while the expansion of the Air Force was proceeding, especially as that expansion coincides with the movement towards a more normal position in which wastage can no longer be replaced from war stocks. The increases embodied in the new Estimates represent no acceleration of the approved scheme of expansion, which has been proceeding and will continue to proceed normally, subject only to unforeseen delays.

Strength and Distribution of the Air Force.

The present strength of the Air Force, apart from training units and establishments, is the equivalent of 54 squadrons. 43⅜ squadrons are organised as such, and there are 21 flights of an average strength of 6 machines (half the strength of a normal squadron) provided for the Fleet Air Arm or for operation from coastal bases. Of the 43⅜ squadrons, 25½ are stationed at home, 8 in Iraq, 6 in India, and 4½ in Egypt and Palestine.

The number of completely formed Regular Squadrons for Home Defence is 18. During 1925-26 the number of squadrons formed will be: Regular 2, Special Reserve 1, Auxiliary Air Force 4. The Special Reserve Squadrons will be manned as regards one-third by regular officers and airmen, and as regards two-thirds by officers and men of the Special Reserve raised under the Act passed last year. The Auxiliary Air Force Squadrons will be manned (except for a small permanent staff) by officers and men raised on a territorial basis under the same Act.

The estimates reflect the arrangements recently agreed to respecting the Fleet Air Arm; a proportion of its officers will be Naval officers attached to the Royal Air Force. All air observation duties in the Fleet Air Arm will be performed by Naval officers, who will not be so attached, and Naval ratings will be substituted for airmen in certain trades in units provided for embarkation in aircraft carriers.

The strength of the Fleet Air Arm will be increased towards the end of the year by four additional flights to meet naval requirements.

Four squadrons will continue to be provided at home specifically to meet the requirements of the Army, the provision for Army co-operation in overseas theatres also remaining unchanged.

As regards Iraq the number of air squadrons remains at 8, and it is expected that this number will be maintained at least until the northern frontier is sufficiently stabilised. It is of course the desire and intention of H.M. Government to reduce the Imperial garrison in that country as rapidly as circumstances allow, and a decision has lately been taken to withdraw the Indian Pack Battery during the present trooping season and to reduce the number of Armoured Car Companies from four to three.

In Egypt and Palestine the equivalent of four squadrons is stationed, one flight being held at Amman in Transjordan, the starting point of the desert air route. Economies have recently been effected by reducing the establishment of the Palestine Squadron by one flight. Provision is also made for the continuance of a flight of three machines at Aden.

Personnel

Vote A, which authorises the maximum numbers of personnel to be borne in or attached to the Air Force during the year is 36,000, an increase of 1,000. Vote 1 (Pay) is increased by £471,000. Apart from increase of numbers during the coming year, the amount authorised under this vote in the current year has proved insufficient, and the money provision would in any case have had to be increased. Votes 5 (Medical Services) and 6 (Educational Services) show slight increases of £9,000 and £6,000 respectively. Additional personnel are required for the new units which as already mentioned are to be formed under the Home Defence scheme. Against this increase in personnel for Home Defence is to be set a reduction in the R.A.F. garrisons of Iraq and Palestine, which does not, however, affect the net Votes.

A considerable part of the increase in Vote 1 falls on Subhead E, pay of civilians employed in Air Force units, who are not shown in Vote A; the services of such civilians are being utilised to a considerable extent in the units at home, whose duties on mobilisation would not take them overseas. It was part of the policy laid down for the development of the Home Defence Force that as much use as possible should be made of civilians. It has also proved possible to effect a measure of such substitution in clerical staffs overseas.

It is proposed to make gradual progress during 1925-26, with the development of the Reserve and Auxiliary forces, and Vote 7 is increased by £64,000. The R.A.F. Reserve receives its flying training at five schools maintained by civil firms. As the useful life of the aircraft employed at

these schools expires, opportunity is being taken to re-equip them with machines of modern type, and the higher cost of training on these machines is reflected in the increased sum allowed under Sub-head D for capitation payments to the firms. This improved training will have an important effect on the preparedness of the Reserve for war. Apart from officers who, on completion of their period of active list service on short service commissions, have passed to the Reserve, the only means of building up a reserve is by direct entry of civilians. Hitherto it has proved possible to enter officers who were already qualified pilots trained during the late war, but this source of supply is becoming exhausted. It is, therefore, under consideration shortly to invite young men to enrol in the Reserve with a view to being taught to fly *ab initio*. Provision has been made for making a start with this scheme.

Under other sub-heads provision is taken for expenses involved in the creation of the Special Reserve and Auxiliary Air Force squadrons, to which reference has been made above. Apart from the cost of the regular staffs, the sums expended during the coming year must depend largely on the intake of volunteers, and the estimate is, therefore, of a tentative character.

Technical Equipment and Research

A net reduction of £400,000 is shown in Vote 3 (Technical Equipment, Experiment, and Research). Allowance, however, has to be made for the grant from Navy Votes in respect of the Fleet Air Arm, and there is, therefore, a real net increase of £763,000. This increase is mainly due to the new squadrons being formed for Home defence and to the larger orders being given for aircraft of modern types. It is to be remembered that, as with all types of fighting equipment, there is a marked tendency for aircraft to advance in power and complexity, and consequently also in cost.

The provision for research and development (shown in Appendix II of the Air Estimates) is slightly increased. The department has during the past year been feeling its way towards a more complete recognition of the scope of pure research, and towards an organisation which will free the technical administration from responsibility for theoretical investigation and enable it to devote its attention to improvements in the production of material of new type.

The work of the Royal Aircraft Establishment at Farnborough will be continued and developed on the same lines as hitherto. It is the considered policy of the Air Ministry to reserve this establishment for experiment and research, and not to employ it on the normal work of production for the Air Force.

In addition to the completion or progress of the experimental aircraft and engines provided for in previous years, the experimental programme of the coming year contemplates the putting in hand of 12 types of aircraft and 12 types of engines. The aircraft include three types for civil aviation.

Airships

In a supplementary estimate presented last May the late Government made initial provision of £350,000 for a programme of airship development in two parts, to be proceeded with concurrently, extending over three years. One part consisted in airship development under the direct control of the Air Ministry, including the construction of one new airship, and the other in the construction of a second airship by a private firm, which might prove the nucleus of a commercial airship service. In my view, however, such a commercial service is at present the principal object to be kept in view; and the programme, which the provision in the present Estimates carries into its second year, is being made sufficiently elastic to render it possible to accelerate as I am anxious to do, the transition to a phase of commercial operation. In the meanwhile the immediate policy is to secure that every step is taken to ensure the safety and success of the experimental stage, especially in view of the fact that these ships are twice as large as any previously constructed. For this purpose an extensive programme of research and experiment is in hand, including in particular the carrying out of the full-scale research on the strength of structures recommended in the report of the Airship Stressing Panel of the Aeronautical Research Committee, dated August, 1922.

The Royal Airship Works at Cardington and the Airship station at Pulham were reopened in July last. In order to obtain reliable data as to the stresses and aerodynamic pressures which are imposed upon the structure of an airship in flight, the R.33 (a sister ship of the R.34 which flew the Atlantic in 1919) has been reconditioned and fitted with special recording instruments, and will shortly carry out a series of experimental flights for this purpose. The R.36 is now being reconditioned at Pulham for an experimental flight to Egypt, after having been tried out at the Cardington mast. In addition, model and full-scale research and experiment has been proceeding at Cardington and at the National Physical Laboratory. Exhaustive trials of experimental girders are also now in progress.

The shed at Cardington is in process of being enlarged with a view to the construction of the new Air Ministry ship. The necessary mooring masts are being constructed in order that the new airships may be able to moor at Cardington and two stations overseas, while the existing mast at Pulham is being reconditioned for the purposes of the aerodynamic trials with R.33. The new Air Ministry ship will not be actually laid down until the girder trials referred to above are completed.

An initial payment of £150,000 has been made to the Airship Guarantee Company on account of the airship they have contracted to build, and the estimate contains provision for further progress payments to the company during the coming year. The total provision for airships under Vote 3 amounts to £500,000.

Works

Vote 4 (Works, Buildings, and Lands) shows a net increase of £445,000 as compared with 1924–25. This increase is more than covered by the increased provision for works services necessary to provide accommodation for the Home Defence Air Force. The provision directly attributable to purchase of land and erection of buildings for the Home Defence Air Force is £1,280,000 (less a proportion of the sum of £200,000 allowed for underspending), as against a provision of £570,000 for similar services during 1924–25. On account of difficulties in connection with the supply of skilled labour, the building programme is proceeding comparatively slowly, and the amounts provided for the various items represent the estimated expenditure after a careful examination of the probable extent of the supply of labour in the districts concerned. There are a certain number of services at home which cannot be deferred until the accommodation for the Home Defence Air Force has been provided, most of which appear this year as continuation services, having been commenced in previous years; but, broadly speaking, attention is, and will remain for some years, concentrated on the "expansion" programme.

During the last few years the problem of works expenditure for the Air Force in Egypt has presented great difficulties. Many urgent services have been deferred until the political situation is clearer, and the distribution and strength of the Imperial Forces in Egypt have been definitely settled. But the continued maintenance of the Force in war-time buildings of the most temporary description is not compatible with its efficiency, and it is not possible to defer altogether the provision of more suitable buildings. It is accordingly proposed to proceed with a few of the most urgent items.

The provision for works services in Palestine, Transjordan and Iraq, the cost of which is recoverable from the Middle East Vote, is reduced to less than half the corresponding figure for the current year.

Civil Aviation

Under Vote 8 provision is made for expenditure in connection with Civil Aviation on the same lines as in last year's Estimates, including the maintenance of the Airport of London at Croydon, the Customs Aerodrome at Lympne, the ancillary services connected with the regularly-operated air routes, and the carrying out of operational experiments, such as night flying and the commercial operation of new types of Civil Aircraft. The Vote as a whole shows an increase of £2,000.

The subsidy to Imperial Airways, Ltd., remains at the same figure as in 1924-25, in accordance with the terms of the Agreement with the Company, conditional on the Company's aircraft maintaining efficient air services for the transport of passengers, mails and freight, and completing an average minimum mileage of 1,000,000 miles per annum.

A sum is also included for the first time this year to assist in the establishment and maintenance of a limited number of Light Aeroplane Clubs. The details of the scheme are still under discussion.

The Director of Civil Aviation is at present in India, having flown there with the object of investigating routes for possible air services. I hope that this, and other enquiries now proceeding, may serve to lay a foundation for the scheme of an Air Route to India, a project which has long engaged the attention of the Air Ministry, and which I am most desirous of furthering.

Provision is again made for progress with the scheme of enlargement and improvement of Croydon Aerodrome in accordance with the recommendations made in 1923 by the

Civil Aviation Advisory Board; additional land has been purchased, but the improvement of the aerodrome cannot be proceeded with until the Bill for the diversion of Plough Lane has been passed.

Meteorology

There are small increases on this service both under Vote 9, Sub-head E (outstations), and under Vote 10, Sub-head F (headquarters). The Meteorological Office is faced by increasing requirements in various directions. Among these may be mentioned the problems connected with airship navigation, and those due to the expansion of the Home Defence Air Force. The former requires a close study of the weather and air currents over large tracts of the earth's surface, including extensive areas for which very few data are yet available, and the organisation of a forecasting service of a special kind; the latter, involving as it will long cross-country flights, and training in night flying on a considerable scale, demands an extension of the present system of interchange of weather warnings, and the establishment of several new meteorological stations.

A noteworthy advance in the collection of data from the upper air has been made possible by the co-operation of the Royal Air Force, regular observations of temperature and humidity being made from aeroplanes whenever the weather allows.

Air Ministry

Vote 10 (Air Ministry) shows an increase of £41,000, of which rather more than £13,000 is due to a further increase in the staff of the Works Directorate, principally in connection with the building programme of the Home Defence Scheme. The balance, in so far as it is not attributable to increments of pay on approved scales, is due to minor increases of staff which also reflect the progress of the expansion of the Air Force.

In this Estimate Parliament is invited to vote the same salary to the Secretary of State for Air as to all the other Secretaries of State. This is a reversion to the arrangement which obtained when the Air Ministry was constituted, the normal salary having been paid to the first holders of the office.

THE AIR ESTIMATES AND THE OLDER SERVICES

THE novel feature of this year's Air Estimates is that the Admiralty pays the cost of the Fleet Air Arm, a sum amounting to £1,320,000. It will be remembered that at the time of the Balfour Committee's report the Admiralty asked for leave to include this cost in its own estimates, and it was agreed that this arrangement should be made subject to Treasury sanction. The arrangement is, obviously, equitable, because the flights, etc., which compose this arm are engaged on purely naval duties, and the cost thereof ought not to be charged to the Air Ministry. A writer in one daily paper considers that in this matter the Admiralty has outwitted the Air Ministry, for "he who pays the piper calls the tune." This is putting the cart before the horse. The Admiralty has been calling the tune by demanding fairly large supplies of seaplanes and ship-planes. It is all to the good that they should do so. It increases the efficiency of the Navy, it increases the total of flying, and it gives more work to our aircraft constructors. In fact, the more aircraft the Navy demands the better. But, having called the tune, it is only right that the Admiralty should pay the piper. At the moment the nation is not inclined to grudge money to the Air Ministry; but the latter body can have no desire to appear before the taxpayers as an unconscionable swallower of millions. Somewhere and some time a limit will be set to the demands of the Air Estimates. When that limit is approached it would be disastrous if the Admiralty had first call in dictating how the money should be spent. No limit should be set to the urgent needs of air defence and the almost pitiful requirements of commercial flying by the demands of one of the older Services. Let the Navy have as many aircraft as it can do with, and let it pay for them. It is an excellent arrangement. In course of time it will mean a saving on light cruisers, at which the taxpayer will unfeignedly rejoice.

The Army, on the other hand, is keeping remarkably quiet, and though as taxpayers we have a natural inclination towards the policy of *quieta non movere*, still, we are not quite sure that this modesty on the part of the War Office is altogether a healthy sign. Perhaps it is afraid of being asked to pay for its own aircraft out of a budget which in recent years has been none too lavish. Four squadrons are allotted by the Air Ministry for army co-operation work in this country, namely, No. 2 at Manston, No. 4 at South Farnborough, No. 13 at Andover (which has only three flights), and No. 16 at Old Sarum—the last named being included in the establishment of the School of Army Co-operation. In addition, there are seven Army co-operation squadrons stationed overseas—Nos. 5, 20, 28 and 31 in India, No. 6 in Iraq, No. 14 in Palestine, and No. 208 in the Middle East (*i.e.*, Ismailia). All of these squadrons are equipped with Bristol Fighters.

Now we have a tremendous admiration for the Bristol Fighter, but, although it may still be called a general utility aeroplane, suitable for reconnaissance, artillery observation, light bombing and fighting, it cannot be expected to carry out any two of those duties at the same time. If the Army were engaged in war with an enemy who boasted aircraft, the Army machines would need escorts of modern fighters, and for them no provision appears to have been made. Is the War Office, we should like to know, trusting that in such an emergency Sir John Salmond will loan them a few squadrons of Siskins out of his exiguous defence force? Such a belief, if it exists, ought to be dispelled at once. In short, we should like to see the Army asking for more squadrons, fighters as well as general co-operation ones, and new equipment for those which have been already allocated to it. A necessary corollary of such a demand must be that the War Office should bear the extra expense and not make a further demand upon the purse of the Air Ministry.

And what about the air defence force? Sir Samuel Hoare has stated in his memorandum that the war stocks are nearly used up. We rejoice that this is so, and we offer respectful and cordial congratulations to the Air Minister for all that he has done and is doing for the Royal Air Force. At the same time, there are still too many fighter squadrons equipped with Snipes, and we are of opinion that nothing but applause would be evoked in the country if the process of re-equipment with modern types were considerably expedited.

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PHOTO-ELASTIC METHODS OF MEASURING STRESS

ON Friday last, February 20, Prof. E. G. Coker, F.R.S., of University College, London, read a paper at his laboratory before the Institution of Aeronautical Engineers on the subject of the Photo-Elastic Methods of measuring stress. Prof. Coker's paper was, to a certain extent, in the nature of an introduction to this most fascinating subject, and it is to be hoped that at some future date Prof. Coker may be persuaded to give us some more, and fuller, details of a subject which would appear to possess great possibilities in its application to aeronautical engineering. In any case, the lecture was highly appreciated by all present, and was certainly one of the most interesting papers that has been read before the Inst.Ae.E.

It may be as well here to explain, briefly, what this method of measuring stress is. A model of the object or shape to be tested is made from a transparent material, and is then supported in a suitable contrivance—in which the necessary forces can be applied to the model—located in the path of polarised light rays. The image of the model is projected on a screen, or is photographed, and by virtue of the polarised rays passing through the model the various stresses are indicated by certain distinct colours assumed by the different parts of the model—or rather its projected image.

We are unable to give Prof. Coker's paper in full, but the following is a brief résumé of the main points dealt with. The application of polarised light to determine the stress distributions in models of parts of machines and structures has been developed so much during the last twenty years that it has now become a reliable and useful means for examining and measuring the effects of loading on various shapes required in engineering practice, for which, as a rule, exact calculations of stress distribution are difficult or impossible.

One of the chief merits of photo-elastic experiments, is that a picture is obtained by aid of which a quantitative examination of one or more designs can be made very rapidly, or the picture can be analysed quantitatively, in as much detail as may be necessary for the purpose. Prof. Coker gave a brief description of the essential principles of the method, illustrated by some excellent slides (natural colour pictures) of simple cases. He also referred to some of the instruments

which have been devised for ease of measurements. The author drew attention to the fact that recently photo-elastic laboratories have been established in various parts of the world, some of which are especially interested in applications to aeronautical problems of stress distribution, and, since it seems probable that this will lead to developments in this field, he made special reference as to its possible uses. Several interesting illustrations were given—such as the case of the simple stiff joint, an aeroplane strut, eye-bolts, and finally, the case of the problem of the stress in a main cross-frame of a rigid airship.

Some suggestions were also made as to the best ways of obtaining the stress distribution in such a case by large-scale photo-elastic experiments in a special form of polariscope. Prof. Coker then dealt with the design of various parts in order to obtain the least weight of aeroplane and airship framing, and concluded with a description of some specific cases in which the general nature of the problem and the methods of solution were outlined. Some extremely interesting pictures of gear-wheel models were shown, in which the stress distribution was clearly shown under various conditions.

At the conclusion of the paper Dr. Thurston expressed the opinion that photo-elastic methods would be of great value in connection with aeronautics, and asked if it would be possible to render wood—which material aircraft constructors had to employ very extensively—transparent, and so obtain an insight as to its somewhat peculiar behaviour under stress by means of the polariscope. Failing this he suggested coating the surface of the wood with silver or the like and placing over this the transparent material, to which the stresses in the wood might be transmitted, and taking the "polarised readings" from this. Another suggestion made by Dr. Thurston was to the effect that it might be possible to build up a structure as near as possible to that of wood—consisting of numerous transparent tubular members "stuck together"—and in this way obtain polarised pictures.

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AMERICA'S SUPER-ZEPPELIN

IN our issue of December 18 last, we published a report to the effect that U.S. Naval and Air experts had laid before Congress plans for an airship of about 6,000,000 cub. ft. capacity. This week we are able, through the courtesy of our American contemporary, *Slipstream*, to give further particulars of this monster airship. These details have been given out by Mr. P. W. Litchfield, Vice-President and General Manager of the Goodyear-Zeppelin Corporation, and may, therefore, be taken as authentic.

Working plans for this super-airship, which will be twice as large as any airship ever built, and slightly larger than the two 5,000,000 cub. ft. airships being built for the British Imperial service to India, were started with the arrival in America last year of Dr. Karl Arnstein, formerly chief engineer to the German Zeppelin Co., and a selected staff of twelve technical men from Friedrichshafen—the birthplace of the Zeppelin. Dr. Arnstein, under whose direction nearly 100 Zeppelins were constructed in Germany, now holds a similar capacity with the Goodyear-Zeppelin Corp., a subsidiary of the Goodyear Tire and Rubber Co., which took over Zeppelin rights for North America.

In answer to the question "Why build an airship of such large capacity as 5,000,000 cub. ft., when smaller ships like the 'Shenandoah' and the Z.R.3, or 'Los Angeles,' have shown themselves capable of accomplishing successfully big flights, such as the 9,000-mile trip twice across the United States, and the 5,000-mile non-stop journey from Germany to America," Mr. Litchfield makes the following statement :—

The most important consideration is that the airship reaches its highest efficiency in the larger units. The larger the airship is, the higher is the proportion of useful lift in comparison to size. The earliest Zeppelins carried only from 10 to 20 per cent. of their weight useful load, while the Z.R.3, inflated with gas and under normal temperature and pressure conditions, weighed when empty about 45 tons, but was able to lift a total weight of some 90 tons—or a useful load of 50-60 per cent. A ship twice the size of the Z.R.3 would not require twice the amount of fuel or twice as large a crew, and would thus have a considerable larger percentage of space for passengers, mail, etc. A ten-million cub. ft. airship could carry a proportionately greater pay load than a five-million cub. ft. ship. However, it is logical to start first in the intermediate size of a five to six-million cub. ft. ship and learn what problems are involved there before going to the next step.

In taking up the design of the five to six-million cub. ft. ship, writes Mr. Litchfield, they are undertaking a new problem, and there are various considerations that must be taken into account. Whether the first requirements of America would be for a military or commercial airship is a primary factor, involving many variations in design.

If the ship is a commercial one, built for speed, then something can be sacrificed in the pay load it may carry. If it is to be built primarily for transport, and the matter of 10 or 15 m.p.h. difference in the rated speed of the engines is not important, the engineers must include that fact in their computations. If the ship is designed for travel over-land—say, between the Atlantic and Pacific Oceans—the altitude to be reached or the ceiling of the ship is an important factor, for on the journey from west to east the airship must carry its maximum weight over the Rocky Mountains, and in the higher altitudes the air pressure is less and the temperature is lower, both factors affecting the lifting power of the gas.

If the ship is designed for coast patrol with the fleet, making comparatively short, but fast, scouting trips, it will have different requirements from a ship that is to carry passengers, mail and express across the Atlantic without opportunity for refueling *en route*. These and other primary facts have to be studied before the final lines of design can be settled, but it is possible to set down in approximate figures at least the general limitations somewhere within which the proposed ship will find itself.

First and foremost the capacity of the gas bags is set at being between five and six million cub. ft. The "Shenandoah" is 680 ft. long and 78 ft. in diameter. The Z.R.3, somewhat shorter and fatter, is 660 ft. long and 101.6 ft. in diameter. This gives a ratio of slenderness for the "Shenandoah" of 8.7, and the Z.R.3 ratio is about 7.2. The proposed super-Zep. may be between 860 and 930 ft. long, the maximum diameter 115 to 120 ft., with the overall height from the ground (*i.e.*, including control car) 10 ft. more, and with a slenderness ratio of about 7.5.

Let the power required to drive this big ship be set down at 4,000 h.p., as against 1,500 h.p. for the "Shenandoah" and 2,000 h.p. for the Z.R.3. With the engines this size a ship should develop a speed of 80 to 85 m.p.h., and driven at a maximum speed with a full fuel reserve, passengers, freight and mail, should have no difficulty in making a 6,000-mile non-stop flight. If driven at a cruising speed of 75 m.p.h., it could go, say, 8,000 miles non-stop.

As to pay load, it might carry, say, from 50 to 125 passengers, 3 to 6 tons of mail, and up to 12 tons of freight over these distances.

What will the ship be like? Assume it is designed for overseas transport as a commercial airship, supplementing the steamship service by giving a two-day service between New York and London for that class of passengers to whom time is important and who would make many more trips a year if they could make the round trip to Europe and back in a week or ten days. We may visualise a passenger cabin, extending along the keel of the hull, with a promenade deck and chairs, comfortable berths, dining-room service, shower baths and the like, furnishing a pleasant and easy journey, without sea-sickness or other discomforts of present methods of travel.

As regards fares, Mr. Litchfield points out that, while thousands of flights were made by Zeppelin airships in the past, when some 35,000 passengers were carried without accident or mishap, the experience in operating airship services has been too limited to draw final conclusions as to the cost of airship travel.

What may be said is that the Zeppelin airships offer a new and faster method of long-distance transport, and that interesting developments are ahead. America is now able to draw upon the accumulated experience of twenty-five years of the Zeppelin organisation in construction and operation of airships. It has the added advantage of American factory methods of construction, etc., plus the fact of a great continent and two great oceans to operate over without having to cross the borders of another nation.

In conclusion, it may be of interest to note that Dr. Hugo Eckener, head of the Zeppelin plant and commander of the Z.R.3 on its delivery flight, will be a member of the board of directors for the Goodyear-Zeppelin Company, his presence and that of Dr. Arnstein and E. A. Lehman (formerly of the Zeppelin Company) being an assurance that the full resources and experience of successful Zeppelin operation will be at America's disposal.

LIGHT AEROPLANE ENGINE DEVELOPMENT

THE paper under above title read by Lieut.-Col. L. F. R. Fell, before a joint meeting of the Institution of Automobile Engineers and Royal Aeronautical Society, on February 19, proved a very interesting one, and produced a valuable discussion. Colonel Fell commenced by saying that it had frequently been stated and written that in order to popularise light aircraft, the first essential was the production of a reliable engine capable of being easily maintained and having a long life, at the same time selling at a low figure. The first part of the paper was then devoted to an attempt to show that this ideal is difficult of attainment, and the second part dealt with a consideration of the various types of engine and their claim to adoption.

Difficulties

The lecturer stated that the public, and even aircraft designers, had been misled as to the type of engine that was really required by statements made in the non-technical and semi-technical press to the effect that it was possible to fly an aeroplane satisfactorily with a motor-cycle engine. At this stage, he said, it was desired to state quite definitely that this was impossible, as figures which would be given later clearly indicated. The method of rating on capacity had caused misapprehension, and the statement had been made that a complete motor-car with an engine of 1,100 c.c. capacity could be purchased at the same price as a light aeroplane engine of similar capacity. It was, however, the normal power that an engine could maintain indefinitely which had to be paid for, and if viewed in this light the light aircraft engine as we knew it today was not particularly expensive. A table was then given showing the horse-power taken from the engines in the last Lympne competition, the *average* figure for the engines considered being 34 b.h.p. This was about three times the normal for a motor-car engine of similar size, and compared favourably with the best Brooklands efforts of engines of similar capacity. Considering that during the competitions certain engines were running at powers fully 50 per cent. in excess of their normal makers' rating, it was not surprising that unreliability was experienced.

Requirements of Light 'Plane Engines

The lecturer divided the requirements of satisfactory light aircraft engines into two heads: (A) Reliability and (B) Light weight in working order. (A) could only be obtained as a result of careful design and laborious and expensive testing on the bench, while (B) was actually more difficult to attain in light aircraft engines than in large ones, for the following reasons:—Though it was true that a slightly higher horse-power per unit of cylinder volume was permissible with the small engine certain parts, such as cylinders, had to be made thicker and heavier than was dictated by stressing, in order to obtain the necessary rigidity. The use of higher horse-power per unit of volumne was limited by propeller speed unless gearing was introduced, which was undesirable, as it put up the cost and introduced vibration unless the engine was multi-cylinder or fitted with a flywheel.

Colonel Fell gave a table of brake horse-power per cubic inch taken from a number of engines, ranging from the Napier "Lion" to the Blackburne and Cherub engines at Lympne, and these indicated that in the case of the Blackburne, when run at 4,000 r.p.m., the brake horse-power per cubic inch was nearly 1.8 times that taken from the Napier "Lion" Series II.

The power/weight ratio of small engines was worse than that of large engines, and the lecturer stated that not one of the light aircraft engines approached 2 lbs./h.p., and were mostly around 3 lbs./h.p. The small engine was at a disadvantage, in that accessories formed a large proportion of the weight, and could not very well be reduced in weight.

On the question of carburettors, the lecturer thought altitude control was a necessity, and to get good results the finest workmanship was required. Dual ignition was essential, and merely to provide a magneto firing two plugs were insufficient. For correct lubrication at high speeds without over-oiling a positive dry base system was indispensable. The design and manufacture of big-ends for a radial engine was probably the most serious problem to be solved in this type of engine, and was the limiting factor in its development. Finally, the light aircraft engine was a high efficiency engine, comparing as far as motor vehicles was concerned, with the rack racing engine only. The most thorough design, the finest materials, and the highest class of workmanship only could, therefore, be employed.

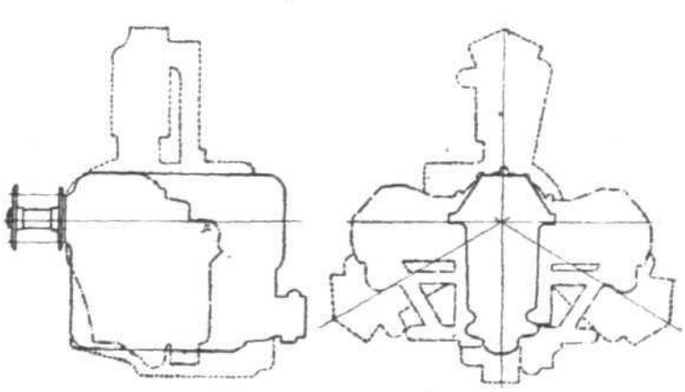
Choice of a Type, and Design Generally

On the method of rating, Colonel Fell then repeated his opinion that rating by capacity was definitely undesirable. The choice of cylinder capacity should be left to the designer, and should only be settled by him after selection of the type of engine he wished to build. It was, he said, safe to say that had the 1,100 c.c. rating not been a necessary condition for the engines to fulfil in the Lympne competition, two-cylinder engines would have been produced with larger bore cylinders running at lower speeds, and having a very much greater reliability at a negligible increase of weight. In the lecturer's opinion the normal ground level horse-power and propeller speed capable of fulfilling the duties of the various classes of light aeroplanes should first be determined and laid down, and the engine builder thereafter be given a free hand to produce an engine of the best power/weight ratio he could at the horse-powers and speeds given, with no other restriction than that his engine must be capable of passing the Air Ministry's standard test of reliability.

On the subject of air-cooling *versus* water-cooling the lecturer was rather in favour of the latter, and showed outline diagrams of a three-cylinder radial air-cooled, a flat twin air-cooled, and a four-cylinder in line water-cooled engine, in order to demonstrate the relative space taken up by the three. The water-cooled was intended to be of the type known in the Air Ministry as an inverted engine, *i.e.*, mounted with its cylinders hanging down from the crank-case. It had been proved, Col. Fell stated, that the air-cooled engine was not necessarily lighter or cheaper than the water-cooled, and that the water-cooled could be produced to give considerably less head resistance than the air-cooled. In support of his contention the lecturer said that owing to the cylinder block construction the water-cooled gave greater rigidity and consequently less vibration. It was a simpler matter to make a multi-cylinder water-cooled, and higher speeds were therefore more easily obtained. These advantages were, he thought, sufficiently great to warrant serious consideration of the water-cooled, and, furthermore, there were in use on the track quite a large number of water-cooled engines capable of performances equal to the requirements for light aircraft; these engines would only require to be developed in a lighter form to make them suitable.

The application of supercharging to light aircraft engines was suggested by the lecturer, but only in the form in which it is now used on the track, *i.e.*, for the purpose of obtaining an output greater than normal for a given capacity. Figures were quoted relating to the increase in power obtained in the 1,500 c.c. Sunbeam racing cars by using the supercharger. The power went up from 50 b.h.p. to 72 b.h.p., or the b.h.p./100 c.c. from 3.33 to 4.66.

Turning to the question of types of engines suitable for light aeroplanes Col. Fell saw no particular merits in the Vee-twin type. Concerning the 180° flat twin, he said that from the point of view of simplicity of design and production this was perhaps the best type. Unless very strong mounting was used, the torque fluctuation was apt to result in damage to the machine structure. Also there seemed to be a limit



Outline diagrams showing space occupied by flat-twin and 3-cylinder radial air-cooled, and 4-cylinder in-line inverted water-cooled engines.

to the cylinder capacity owing to difficulties experienced in balancing when the bore was more than 90 mm. Carburation was a source of trouble, and sometimes it had been necessary to fit a carburettor to each cylinder. Owing to the comparatively large dimensions of the cylinders it was not particularly suitable for running at high speeds, but the fitting of a supercharger should enable a reasonably well-balanced engine to be produced giving about 38-40 h.p. at a speed of under 3,000 r.p.m. The type was easy to air cool, and should also have a fairly good power/weight ratio.

The lecturer referred to an experimental 180° flat four with the cylinders in two blocks of two at 180° which had been built in France. If it was admitted that there was a limit to the capacity of the flat twin it seemed obvious that the flat four could be designed up to double the capacity. The three-cylinder radial type was criticised by the lecturer on account of its large frontal area, and also because of a greater weight resulting from difficulties in the construction of the big-end bearing. A neat induction system was difficult to arrange, and the central top cylinder was in the way from the pilot's point of view. The balance was superior to that of the flat twin and the torque-recoil less. The lecturer appeared rather in favour of the five-cylinder radial for larger engines, as the five-cylinder crankcase need be no larger than that required for a three-cylinder radial. Although somewhat expensive, this type was, he thought, very promising.

For small engines Col. Fell thought the "swashplate" type of engine, with the cylinders parallel to the driving shaft, could be satisfactorily designed. It should be capable of high speeds, and it should give low head resistance and reliability, and be comparatively cheap and easy to produce.

The lecturer thought it curious that the four-cylinder in line type had not come into prominence for light aircraft although it was by far the most extensively used in motor-car practice. He thought it probable that owing to faulty cooling of the rear cylinder it would not be possible to obtain the high duty called for in the air-cooled form of this type of engine, but in the water-cooled form the type had much to recommend it. In the air-cooled form the engine must be somewhat long to give space between cylinders, and for rigidity it depended entirely on the crankcase. Reference was again made to the small frontal area of the water-cooled four-in-line type, and Col. Fell explained that the engine was intended to be of the inverted type. The water-cooled type had to have the additional weight of water and pipes and radiator, but the weight of these items was largely offset by the increased cylinder and piston weights of the air-cooled. For a light aircraft engine it would be possible to build in the radiators close to the sides of the engine, and so eliminate water piping. In the design shown in the diagram it was intended that the radiators should be formed by two nests of "Brown" tubes, each a block of approximately 3 ins. diameter, and running the whole length of the crankcase on each side of the cylinder liners located at the highest point of the water space.

As a luxury rather than an essential type the lecturer referred to the straight six and straight eight, and said he had recently had an opportunity of considering a proposal for a 1,500 c.c. eight-cylinder-in-line design to give 70 h.p. continuously at a speed of 5,000 r.p.m. Finally he summed up as suggestions for the most suitable types the following: For single-seaters 180 deg. flat twin air-cooled. For two-seaters five-cylinder radial air-cooled or four-cylinder-in-line water-cooled. For luxury or speed machines six or eight-cylinder in-line water-cooled.

Installation

Col. Fell criticised the installation of some of the engines at Lympne, particularly engine mountings. He thought the engine designer might have rendered considerably more assistance to the machine designer by supplying satisfactory bearers as part of the engine. It was sometimes argued against this procedure that it hampered machine design, but in practice this difficulty had not become apparent The great advantage was that the engine designer could test his engine in the same way as it would have to run when fitted into the machine.

Cowling also might with advantage be designed by the engine designer and supplied as part of the engine, but against this was the difficulty caused by the different body shapes of the various machines. Attention was also called to the importance of adequate fire prevention, of rigid engine controls in place of cable, and of accessibility to the engine and its auxiliaries generally.

Conclusion

In conclusion Col. Fell said:

"In the writer's opinion, as is the case with all other aircraft, the successful development of light aircraft for any purpose whatever depends on the engine designer. The competitions so far have indicated that the light aircraft engine builder's problem is a far more serious one than was anticipated. In this lecture the writer has indicated why this is so, and that it is only by the very best work of those most highly skilled in high efficiency internal combustion engine design that an engine sufficiently powerful, and at the same time, durable, can be produced. The light aircraft engine must always be more expensive than any other engine of similar capacity for the simple reason that, in addition to the fact that it will always be called upon to give the maximum duty obtainable from its capacity, as is the case with the racing motor-car engine, it has the further disadvantage of having to be produced at minimum weight. It will no doubt be stated that the maximum possible rating will not be used, and that reliability shall be accepted in lieu. It has been the writer's experience, however, during the last ten years, if there is anything left in the way of power inside an engine, the aircraft designer will have it out, and he sees no reason why this is less likely to be the case with the light aircraft engine. It is absolutely essential that an aero engine be designed to withstand indefinitely the maximum duty which it is possible to obtain by running full throttle under the best possible settings for carburettor and ignition for maximum power."

THE DISCUSSION

Colonel Bristow pointed out that it was through no fault of the aircraft people that the capacity limitation was chosen, but that a daily newspaper, the name of which escaped him for the moment, had a competition for motor gliders and wanted the capacity rating. For this year's light 'plane competitions the basis to be used would be one of total loaded weight of the machines. He pointed out what appeared to be an inconsistency in the paper, where the lecturer first stated that capacity rating was definitely undesirable, and then went on to suggest that more power could be got out of an engine for a given capacity by the use of a supercharger. He thought it would be much simpler to get that extra power by a slight increase in the cylinder dimensions, and also a much lighter engine would result. He thought the weight of the super-charged engines on Brooklands track was 11 lbs./h.p. complete with blower. On the subject of motor-car racing engines Col. Bristow pointed out that the plain air-cooled engine was giving 5 h.p. per 100 c.c. capacity on the track as compared with the 4.66 h.p./100 c.c. mentioned by the lecturer for the supercharged water-cooled racing car engine. He was sorry the lecturer asked for dual ignition, and thought one magneto firing two plugs was sufficient, and this had been found to give smoother running. He was surprised at the lecturer's statements relative to the respective weights of water-cooled and air-cooled engines, and stated that whereas the lightest type-tested water-cooled engine weighed 2·2 lbs./h.p. the lightest air-cooled weighed but 1·6 lbs./h.p.

Mr. Manning pointed out that the light 'plane engine *must* be a cheap engine, and that the air-cooled was the cheapest type. The lecturer had stated that it was definitely not possible to fly satisfactorily with motor-cycle engines. He would point out that the Blackburne in the D.H.53 was giving very good service. The lecturer had also said that figures would be given showing that motor-cycle engines were no use. These figures, apparently, had been omitted, as the tables did not refer to motor-cycle engines. With regard to the question of altitude control, he had seen in France on a Claudel carburettor a simple sleeve arrangement which appeared satisfactory. On the subject of water-cooling *versus* air-cooling he thought the air-cooled undoubtedly scored on the question of weight, as one had to allow about 0·6 lb./h.p. for the water-cooling apparatus. As to the use of superchargers, the cost was against it, and he thought it better to increase the size of cylinders. The lecturer had objected to the four-cylinder-in-line air-cooled engine. There was in use a French engine of this type which was running very well and was giving no trouble. Concerning the size of the future light 'plane engine, Mr. Manning thought this should develop 50–60 b.h.p. at a speed not exceeding 2,000 r.p.m. He did not quite agree with the lecturer in the need for dual ignition, and thought one magneto sufficient. The question of cost should be kept prominently in mind, and he suggested developing the four-cylinder-in-line and the three-cylinder radial.

Mr. Fedden, although he admitted that giving designers an entirely free hand was a very attractive proposition, thought that, in view of the fact that light 'planes would presumably

be used for racing, etc., it was dangerous to abolish all limitations on capacity. He did not agree with the lecturer that air-cooled engines were no lighter than water-cooled, and thought it a pity to introduce water-cooled engines for light 'planes. The air-cooled engine was much easier to overhaul, and the water-cooled was some 20 per cent. heavier and some 25–30 per cent. more costly. With regard to the use of superchargers, this was an interesting future development for racing or competition work, but he did not think it necessary for ordinary practical work in the near future. He agreed with the lecturer that the highest class of workmanship and the fullest degree of interchangeability were demanded. Simplicity should be the keynote, and for the next few years at any rate manufacturers of light 'plane engines could not expect large orders which would enable them to spend a big outlay on jigs and tools. Furthermore, it might be expected that when more firms came into the industry competition would be keen and developments rapid. The two-cylinder type was simple to build, and we should stick to it.

Captain Wilkinson referred to Mr. Fedden's remarks concerning the risk of doing away with any sort of limitations on capacity, and thought that for racing purposes it would be possible, and sufficient safeguard, to place a limit on the weight permitted for engine and machine. If, he said, we were to have another competition for light aeroplanes, it would be advisable to postpone it, as it took two years to develop a new engine, and thus engine manufacturers would not be able to produce new types in time for a competition this year. He, therefore, suggested that it would be wise not to hold a competition this year.

Mr. Parnacott doubted whether the so-called high-efficiency engine really was efficient, as the early opening of the exhaust valve must result in less energy being extracted from the fuel. With reference to the swashplate engine, he understood that the main trouble was with the driving shaft, and suggested tapering this, placing the greatest section at the swashplate so as to get uniform stress throughout the shaft. To increase the safety from fire, he suggested that the Diesel type of engine be considered, even for these small machines. He had had considerable experience with two-cylinder opposed engines, and was in favour of that type for light 'planes. It was possible to design this type of engine without staggering the cylinders, and the rocking couple was not then set up.

Captain Sayers said that the only thing in the paper with which he agreed was the first paragraph, in which the lecturer stated that in order to popularise light aircraft the first essential was the production of a reliable engine, capable of being easily maintained and having a long life, and at the same time selling at a low figure. The lecturer had, however, proceeded to assume that this was not possible, and had based the rest of his paper on this assumption. He (Captain Sayers) had been rather intimately concerned in the design of a small aeroplane at the Isle of Grain, the machine being fitted with a flat-twin A.B.C. "Gnat" engine of 40 h.p. When running up the engine on the ground it was found that several of the aeroplane's structural members broke on account of the vibration, although they were amply strong for ordinary flying stresses. Ultimately the trouble was cured by mounting the engine on rubber buffers, and the amount of vibration that was then transmitted to the machine structure was no greater than that caused by a rotary engine in a larger machine. In one of the machines at Lympne, fitted with an engine of the flat-twin type, a similar remedy was tried, but in this case the carburettor was mounted in such a way as to project laterally beyond one of the cylinder heads. The result was that the carburation was upset, because as the engine oscillated on its spring buffers the carburettor was jumped up and down, and it was found impossible to keep the needle on its seating.

As regards high-efficiency engines, so called, he had had no experience of motor-car engineering other than that of a user of some 20 years, but he had always thought the reason for the small-capacity high-speed engine was to cheat the Treasury rating. That the lecturer himself did not really believe in this type of engine seemed to be shown by the statement in the paper that had there been no limit on capacity at Lympne undoubtedly many two-cylinder engines would have been produced with larger-bore cylinders and running at lower speeds, with consequent gain in reliability. He did not consider the so-called high-efficiency engine necessary for light 'planes.

Mr. L. F. Little regretted that no mention had been made of the two-stroke engine for light aeroplanes. He had, he said, been connected with the production of the Carden engine fitted in the Gloucestershire "Gannet" light 'plane, and although success was not then attained, he thought the type offered certain not inconsiderable advantages. In the case of the Carden engine this was not finished until a fortnight before the competition, and there was thus very little time for experiment and development. The trouble was overheating, but he thought the four-stroke engines suffered from the same trouble. In the Carden it was found that oil leaked down between the liner and the cylinder, and thus prevented the transference of heat to the fins. Experiments made later showed that the engine was not exposed to a sufficient current of air. Thus at the height of the exhaust ports the air-speed was only 10 miles per hour. Mr. Little gave some interesting figures relating to the Carden. The total weight was 36½ lbs., and the engine developed 13 h.p. at 2,300 r.p.m., and 15 h.p. at 2,500 r.p.m. It was very light, weighing but 2¾ lbs./h.p. on rated power and 2·4 lbs./h.p. on maximum actual power. It had been said that the fuel consumption of the two-stroke was bad. At Lympne it had not been possible to carry out very thorough consumption tests, but on the one authentic test carried out the consumption was 0·6 lb./h.p./hour, which could not be considered bad. This was at a speed of 2,000 r.p.m.

Colonel Cave-Brown-Cave expressed himself in favour of the water-cooled four-cylinder-in-line type, as it gave much less head resistance. The radiators would be mounted close up to the sides of the engine, and be integral with it. On the question of the supercharger, he thought that if this were used in conjunction with the two-stroke engine, that type would be given a new lease of life. Several others spoke, but space does not permit of including their remarks.

In replying, Colonel Fell said that his remarks on use of supercharger were not inconsistent, as had been claimed, since what he meant was that the supercharger be used for the flat-twin type in order to get more power out of it. This could not otherwise be got out of that type of engine, as it only worked satisfactorily up to a certain size of bore. As regards the question of price, this rested with the aircraft designer to a large extent. If he was willing to accept engines weighing 5 or 6 lbs./h.p., then engines could be produced cheaply. With reference to Mr. Manning's remarks that one had to allow 0·6 lb./h.p. for water-cooling, he would point out that on the water-cooled type as compared with the air-cooled one could save about 0·4 lb./h.p. on cylinder weight and about 0·1 lb./h.p. on piston weight, so that there was not much in it. With reference to Mr. Parnacott's suggestion to hold a competition for engines rather than for machines, there was always in such competitions a great risk of some little minor defect putting an otherwise good engine out of the running, although it might in reality be the best of the lot. On the subject of two-strokes, they would require a separate blower, which would introduce complication. He very much wished that the question of what powers *are* required could be settled, and suggested the formation of a committee to consider the matter.

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Roumanian Pilot Killed at Coventry

MAJ. STEFAN SANATESCU, of the Roumanian Flying Force, who was engaged in acceptance tests of aircraft at the Armstrong-Whitworth works at Coventry, met with a fatal accident when flying at the aerodrome on February 18. He had just left the ground when the machine dived and crashed.

Croydon Air Disaster Inquest

THE inquest on the seven victims of the Croydon air disaster on December 24, after having been adjourned pending the public inquiry, was resumed on February 12. Dr. Jackson, the coroner, said that there had been a very full inquiry and it appeared that the evidence was not such as would justify the jury returning a verdict of criminal negligence against anybody. As a result of the finding of the public inquiry the proceedings at the inquest were naturally brief, and were concluded on February 18, when the jury brought in a verdict of "Death by Misadventure." The jury further expressed the opinion that, so far as Imperial Airways were concerned, the people responsible for the safety of the machine, no one was to blame.

A Warsaw-Bucharest Air Service

LAST week two Junkers aeroplanes belonging to the Polish Aero-Lloyd Co. and carrying several passengers, including representatives of the Polish Foreign Office, carried out a test flight between Lvov (Lemberg) and Bucharest with a view to obtaining data in connection with the establishment of a regular passenger and mail service between Poland and Roumania. Negotiations are now in progress with the Roumanian civil aviation authorities in respect to such a service, which it is hoped will commence about May next.

FLIGHT
AIRCRAFT ENGINEER AND AIRSHIPS

THE ROYAL AIR FORCE

London Gazette, February 17, 1925

Air Marshal Sir J. M. Salmond, K.C.B., C.M.G., C.V.O., D.S.O., is appointed Principal Air A.D.C. to the King (Feb. 10), (vice Air Chief Marshal Sir H. M. Trenchard, Bt., G.C.B., D.S.O.). Group Capt. C. F. Kilner, D.S.O., is appointed Air A.D.C. to the King (Jan. 1) (vice Air Commodore C. L. N. Newall, C.M.G., C.B.E., A.M.).

General Duties Branch

The following Pilot Officers are promoted to the rank of Flying Officer :—H. I. Cozens (Dec. 14, 1924) ; C. Mackenzie-Richards (Feb. 14) ; F. J. Fressanges (Feb. 15) ; N. A. P. Pritchett (Feb. 15). The following Pilot Officers on probation are confirmed in rank (Dec. 30, 1924) :—C. R. Cubitt, R. N. T. Gape, H. C. V. Jolleff, R. C. L. Limbert, A. L. Ottway ; V. B. Bingham-Hall, M.C. (Feb. 2) ; B. F. H. Harding (Feb. 9). Flying Officer S. A. Conway is placed on the retired list (Feb. 14). The following Pilot Officers on probation resign their short service commns. (Feb. 9) :—D. P. Clayton, R. C. B. Hendy, J. H. Hunter (Lieut., R.A.R.O., Worcs. R.). Flight-Lieut. W. M. Smith relinquishes his short service commn. on account of ill-health and is permitted to retain his rank (Feb. 18). Pilot Officer I. B. Pigott relinquishes his short service commn. on account of ill-health (Feb. 17). The short service commns. of the following Pilot Officers on probation are terminated on cessation of duty :—L. Connolly (Feb. 11) ; C. N. Boswell (Feb. 18.) Flying Officer H. W. Iles is cashiered by sentence of General Court Martial (Jan. 28). Flying Officer R. de H. Hutchinson is dismissed the service by sentence of General Court Martial (Jan. 28). *Gazette* of Jan. 20, concerning Flying Officer C. P. Wingfield, is cancelled.

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the R.A.F. are notified :—

General Duties Branch

Squadron Leaders.—A. J. Butler, O.B.E., M.C., A.F.C., to No. 216 Sqdn., Egypt ; 16.1.25. A. T. Williams, to No. 2 Flying Training Sch., Digby ; 16.2.25. T. W. Elsdon and A. Coningham, D.S.O., M.C., D.F.C., to H.Q., Egypt ; 17.12.24. A. J. Currie, to H.Q., Egypt ; 1.1.25.

Flight Lieutenants.—H. O. Fellowes, to Stores Depot, Egypt ; 16.1.25. J. S. T. Fall, D.S.C., A.F.C., to No. 4 Flying Training Sch., Egypt ; 2.225. A. J. Osborn, to No. 28 Sqdn., India ; 5.1.25. A. J. Warwick, to Aircraft Depot, Egypt ; 26.1.25. L. O. Brown, D.S.C., A.F.C., to Boys' Wing Cranwell ; 12.2.25. A. P. Ledger, M.B.E., to H.Q., Air Defences of Great Britain ; 16.2.25. G. W. Hemming, D.S.C., and G. S. Shaw, to No. 480 Flight, Calshot ; 16.2.25. T. E. Salt, A.F.C., to No. 47 Sqdn., Egypt ; 1.2.25. A. M. Blake, A.F.C., to Heliopolis Details, Egypt ; 1.2.25. R. W. Dawes, to H.Q., Egypt ; 20.11.24. H. W. Baggs, to No. 4 Flying Training Sch., Egypt ; 28.12.24. R. B. Mansell, O.B.E., to No. 12 Sqdn., Andover ; 20.2.25. A. Durston, A.F.C., to Sch. of Naval Co-operation, Lee-on-Solent ; 1.3.25. H. M. K. Brown, to No. 4 Flying Training Sch., Egypt ; 20.12.24. E. I. Bussell, to No. 12 Sqdn., Andover, instead of to No. 11 Sqdn., as previously notified ; 16.2.25. J. Whitford, to No. 12 Sqdn., Andover ; 24.2.25. W. R. Castings, M.B.E., to H.Q., Iraq ; 6.2.25. J. D. S. Denholm, to No. 216 Sqdn., Egypt ; 20.12.24.

Flying Officers.—A. J. E. Broomfield, D.F.C., to No. 20 Sqdn., India ; 5.1.25. R. D. V. Howard, to No. 4 Flying Training Sch., Egypt ; 12.1.25. C. Sutton, to Heliopolis Details, Egypt ; 20.1.25. R. K. Emerson, to No. 216 Sqdn., Egypt ; 15.1.25. S. T. Clemens, to Marine Aircraft Experimental Estab., Felixstowe ; 16.2.25. E. A. Blake, M.M., to No. 480 Flight, Calshot ; 11.2.25. W. R. K. Atkinson, to Heliopolis Details, Egypt ; 17.12.24. F. T. Jacobs, to the Packing Depot, Ascot ; 27.2.25. W. F. Shaylor, to No. 17 Sqdn., Hawkinge ; 20.2.25. J. Dunn, to R.A.F. Depot (Non-effective Pool), on transfer to Home Estab. ; 16.2.25. C. P. Wingfield, to No. 1 Stores Depot, Kidbrooke ; 9.2.25. R. Legg, to No. 208 Sqdn., Egypt ; 28.12.24. R. F. Carter, to No. 11 Sqdn., Netheravon ; 16.2.25. A. L. R. Duke and G. N. P. Stringer, to No. 39 Sqdn., Spittlegate ; 16.2.25. W. F. Humphrey, to No. 111 Sqdn., Duxford ; 16.2.25. M. E. B. P. Storrie, to No. 17 Sqdn., Hawkinge ; 16.2.25.

IN PARLIAMENT

Mail Service Air Routes

MR. WARDLAW MILNE, on February 17, asked the Postmaster-General whether he has considered the possibility of subsidising an air-mail service between Port Said and Karachi to carry Indian mails, and also the possibility of conveying Australian mails by air ?

Sir W. Mitchell-Thomson : Responsibility, so far as the Government is concerned, for opening up, and, if necessary, for subsidising, new air routes, rests with the Air Ministry and not with the Post Office. If a regular air service to Karachi or to Australia were instituted it would be used for the conveyance of letters prepaid with the requisite air fee.

Cairo-Bagdad Air Mail

VISCOUNT SANDON, on February 18, asked the Secretary of State for Air if any steps are being taken to remedy the deficiency in skilled personnel and to improve the quality of the aircraft on the Cairo-Bagdad air-mail route ?

The Under-Secretary of State for Air (Major Sir Philip Sassoon) : My Noble Friend's question is based, I think, on a misunderstanding. The primary object of the operation of the desert air route is not the carriage of mails but the affording of a training exercise to pilots and ground personnel of the Royal Air Force in long-distance flying under conditions similar to those of active service and the employment under the same conditions of various standard types of aircraft and engines. This object would not be attained if the operation of the route were restricted to a few highly specialised personnel or to any one particular type of machine. I would add, however, that the delays due to engine or other failures of aircraft flying over the route have decreased progressively since it was initiated.

R.A.F. Fleet Arm Estimates

VISCOUNT SANDON asked why the Estimates for the Naval Air Arm are being placed on the Navy Vote, in view of the terms of the Report of the Committee of Imperial Defence, which was accepted by the Government in 1923 ?

Sir S. Hoare : Provision for the Fleet Air Arm continues to be taken in the gross of Air Estimates as heretofore. An Appropriation-in-Aid is also taken, however, representing a grant from the Admiralty in respect of its cost. This latter sum will be voted in Navy Estimates. This procedure was decided upon by the Treasury, with Admiralty and Air Ministry assent, in accordance with the suggestion in the fourth recommendation of the Sub-Committee of the Committee of Imperial Defence upon the Relations of the Navy and the Air Force (Cmd. 1938).

Aircraft Stalling Speed

CAPTAIN W. BENN, on February 19, asked the Secretary of State for Air what research is being carried out in the matter of the stalling speed of aeroplanes ; and what results have been obtained ?

Sir S. Hoare : In reply to the first part of the question, the investigation of the factors influencing the stalling speed of aircraft is a duty of a special panel of the Aeronautical Research Committee. This panel consists of eminent authorities, and co-ordinates the experimental and theoretical research at the National Physical Laboratory and the Royal Aircraft Establishment, Farnborough, with the general advances in aerodynamical knowledge with which the subject is fundamentally connected. Full-scale flying tests are also carried out at Farnborough, and three special aircraft to be used in the investigation of the problem are being constructed at the request of the Aeronautical Research Committee. With regard to the second part of the question, general advances have been made in our knowledge of the behaviour of aircraft at stalling and lower speeds. Promising tests have been made in flight of a device which automatically warns the pilot that his aircraft is in danger of stalling : an aeroplane of novel type has made gliding tests which may throw much light on the problem ; and work is being continued with a method of control which may reduce the danger arising from a stall while an aircraft is turning close to the ground.

Proposed London-Prague Service

SIR H. BRITTAIN asked whether any settlement has yet been reached which will enable the London-Prague service to be put into operation ?

Sir S. Hoare : I regret to say that the position is still as stated in my reply to my hon. friend on December 18 last.

Continental Air Services

SIR F. SYKES asked the Secretary of State for Air whether he is aware that for practical purposes the flight of British civil aircraft in Europe is confined to France, Belgium, Holland, Italy and Greece ; and what steps are being taken to extend the scope of development of British air transport ?

Sir S. Hoare : Regular services are carried on by British civil aircraft, not only to France, Belgium and Holland, but also to Germany (both Cologne and Berlin) and (except in the winter) to Switzerland, while occasional flights are also made to various other countries. The possibility of the opening up of new services is constantly under consideration both by the Air Ministry and by Imperial Airways, Ltd., but there is an obstacle to any central European extension at present in the difficulty of making arrangements for flying over German territory.

Air Strength of Great Britain and France

LIEUT.-COMMANDER KENWORTHY asked the Secretary of State for Air if he has any information as to the number of aeroplanes and seaplanes maintained ready for service by the Government of the French Republic ; how many of these are in Europe ; how many efficient machines are in reserve ; and the corresponding numbers maintained in Great Britain and Ireland ?

Sir S. Hoare : The combined strength of the French naval, military and Colonial air services, according to the latest information available, is approximately 140 squadrons, of an average of nine machines each. This figure does not include any squadrons now in process of formation, as to which, so far as I am aware, the French Government have not published any particulars. The number of squadrons in Europe is 110. I have no information as to the number of reserve machines in the French service. The number of Royal Air Force squadrons, of 12 machines each on the average, in Great Britain and Ireland is 30, including the equivalent of four and a-half squadrons, which is the present allotment for the Fleet Air Arm in home waters. It would not be in the public interest to state the number of machines held in reserve for the Royal Air Force.

R.A.F. Cairo-Bagdad Service

SIR F. SYKES asked whether records have been compiled of the cost of operating the Cairo-Bagdad air service ; and whether details of those costs can be published ?

Sir S. Hoare : The answer is in the negative. The air service in question is primarily maintained for service reasons, and it would be difficult and probably impossible to prepare a statement of the cost on a commercial basis.

Permanent R.A.F. Commissions from the Universities

THE Air Ministry announces that on the recommendation of their universities the undermentioned graduates were appointed to permanent commissions as pilot officers in the General Duties Branch of the Royal Air Force on January 17 with an antedate in each case of 12 months' seniority, under the university candidates scheme of entry :—

Charles Ronald Hancock, Cambridge University ; Allen Henry Wheeler, Cambridge University ; John Henry Powle, Bristol University ; Charles Herbert Tighe, Dublin University.

New York-Chicago Night Air Mail

IT has been decided to establish an overnight air mail service between New York and Chicago early this spring. The 780 miles between these two cities will be provided with the necessary lighting arrangements, emergency landing fields, &c., and the time occupied by the westbound flight will be 9 hours, and for the eastbound 8 hours, as against 20 hours by rail. Machines will leave New York at 10 p.m. E.S.T., arriving at Chicago at 6 a.m. C.S.T. Departures from Chicago will be at 9 p.m. C.S.T., the time of arrival at New York being 6 a.m. E.S.T.

BEARDMORE AIRCRAFT FOR ABROAD

THE advance in aerial fighting machines in the six years since the Great War is well reflected in the design of a batch of two-seater military biplanes, the order for which has been secured by William Beardmore and Co., Ltd., Glasgow, for a Continental Government.

Each machine has a top speed of 148 miles an hour, and can climb to 16,000 ft. in 20 minutes with full load. Three machine-guns, of the latest Beardmore-Farquhar type are carried, two for the pilot and one for the gunner, the latter carried on a special Scarff mounting, balanced to obviate the terrific force of the wind in the back seat. A special form of under carriage, patented by the builders and incorporating spiral springs in compression in conjunction with Ferodo-faced damping plungers, is employed.

Technically, the structure is of interest in that it will be exceptionally difficult to cripple by machine-gun fire. No bracing wires whatever are used in any part of the machine. All controls are operated by direct-acting rods or torsion tubes, and no cables running over pulleys are employed. The tail, a semi-cantilever structure employing only one bracing tube, is thus particularly clear of obstructions, so as to allow a complete field of fire in this direction. Finally, the petrol is carried in tanks in the top plane, employing a simple gravity feed which is not easily put out of action, or likely to go wrong. The engine is a Rolls-Royce Eagle IX.

Designs have also been completed for a single-seater fighter and a two-seater reconnaissance seaplane. The former is a strutbraced parasol monoplane, and is fitted with the Bristol "Jupiter" Mark V engine, incorporating the new variable timing gear for obtaining increased performance at altitudes. An undercarriage of an entirely new design is fitted giving a wheel track of 9 ft. 6 ins. The machine has a very high top speed and a remarkable rate of climb. The seaplane is a low wing monoplane with strut bracing to floats and wings, and is fitted with a Rolls-Royce "Eagle" IX, engine.

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The Secretary of State for Air

IT is reported that the Government has decided to raise the status of the Secretary of State for Air, Sir Samuel Hoare, to rank equally with the Secretaries of State for War, India, the Colonies, and Foreign Affairs.

Sir Sefton Brancker's Homeward Flight

SIR SEFTON BRANCKER, Director of Civil Aviation, who is flying home from India in the D.H. 50 biplane (230 h.p. Siddeley "Puma") piloted by Alan Cobham, flew from Delhi to Karachi on February 18, covering the 800 miles in about nine hours.

Brussels-Congo Flight

LIEUT. THIEFFRY, who, accompanied by his mechanic, de Bruycker, who is flying a 3-engined Handley Page biplane from Brussels to Kinshasa, in the Belgian Congo, has succeeded, with great difficulty, in crossing the Sahara, and has arrived safely at Gao, on the Niger.

Paris-Dakar Flight

CAPTAIN LEMAITRE and Capt. Arrarchard, the French Army airmen who flew from Paris to Dakar on a Breguet XIX.A.2 (480 h.p. Renault), have reached Timbuctoo from Bamako.

U.S. Airship "Los Angeles" Flies to Bermuda

THE U.S. Zeppelin airship "Los Angeles" (Z.R.3), which flew from Germany to America last October, made another big flight last week-end. The airship left Lakehurst at 3.45 p.m. on February 20 for Bermuda, carrying a consignment of U.S. mails. Capt. Steele was in command, assisted by Capt. Klein, and in addition to the crew of 40, Mr. T. D. Robinson, assistant secretary of the Navy, and Rear-Admiral Moffett were on board as passengers. On the outward journey rain and fog was encountered, and in spite of a head wind the airship made an average speed of 56 m.p.h. The 676 miles from Lakehurst to Hamilton, Bermuda, was covered in 12 hours, but heavy weather prevented the airship being moored to the *Patoka* (the converted tank-steamer fitted with a mooring mast), which was stationed at Hamilton for the purpose. The mails were therefore dropped from the airship on to the lawn in front of Government House, and the "Los Angeles" turned homewards, after having cruised around for several hours. The return journey was successfully accomplished, and the airship was safely moored at Lakehurst early in the morning of February 22. Another attempt to fly to Bermuda and moor there will be made this week. It is reported that the "Los Angeles" will make a flight to Europe (London) and back, with special mails, this summer.

Experiments with Pilotless Aeroplane

AN interesting demonstration will take place at Istres next month with a wireless-controlled aeroplane which will have neither pilot nor passengers on board. Tests have already been made with this system of wireless control—the invention of M. Max Boucher—in which a pilot, after taking the machine off the ground, did not touch the controls again until about to land.

An Ulster Air Service

IN addition to the Carlisle-Belfast air service shortly to be operated by Northern Air Lines, it is proposed to establish another service linking up Londonderry with Belfast.

City Air Force Squadron

IT is almost certain that the headquarters of the City of London Auxiliary Air Force Squadron (No. 600 City of London (Bombing) Squadron) will be Finsbury Barracks. Incidentally, the City Territorial Association—which has accepted the responsibility of raising volunteer air units—will in future be known as the Territorial Association and Auxiliary Air Force Association for the County of the City of London.

"The Advantages of Metal Construction"

WILL readers please note that, to suit the convenience of the author, the paper "The Advantages of Metal Construction," to be read before the Institution of Aeronautical Engineers by M. E. Dewoitine, has been postponed to some date in May next instead of on March 6 as originally announced.

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PUBLICATIONS RECEIVED

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